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The Engineer

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The French Commission on Fuel.

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Suction Gas Vehicle Trials in France.

PUBLIC NOTICES

The High Commissioner for India is prepared to receive TENDERS for the SUPPLY of—

1. SAW BLADES for STONE SAWING PLANT.
2. GALVANISED IRON WIRE, 450 lb. per mile.
3. TRAILER WAGONS for ROAD ROLLERS.
4. CAST IRON SOIL and WASTE PIPES.

Forms of Tender may be obtained from the Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, and Tenders are to be delivered at that office not later than Two o'clock p.m. on Friday, the 22nd September, 1922.

T. RYAN, Director-General.

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The High Commissioner for India is prepared to receive TENDERS for the SUPPLY of :—

3000 RAILWAY WAGONS.

Forms of Tender may be obtained from the Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, and Tenders are to be delivered at that office not later than Two o'clock p.m. on Tuesday the 17th October, 1922.

T. RYAN, Director-General.

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Architectural Assistant REQUIRED by the GOVERNMENT of HONG KONG for service as an Engineer in the Architectural Office of the Public Works Department, for a period of three years, with possible permanency. Salary £460, rising to £500 per annum, and thereafter, if appointment made permanent, to £600 per annum by annual increments of $20. The salary is converted into dollars at the Government rate of exchange, at present fixed at 2s. to the dollar, but this rate is open to revision. Conveyance allowance of 240 dols. per annum. Free passages provided. Candidates, unmarried, 25 to 30 years of age, must be architects' duly qualified assistants and belong to the R.I.B.A. or possess some equivalent diploma. Must be conversant with all the usual routine of an architectural office, including the preparation of sketch designs and working drawings, specifications, quantities, measuring, &c., in connection with new buildings, additions and alterations. Should also have had experience in the design and execution of steel and reinforced concrete structures. Some experience in the maintenance of buildings is desirable, and municipal experience preferred.

Apply at once, by letter, stating age, qualifications, and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1., quoting M/11,544. 156

Chief Accountant REQUIRED by the GOVERNMENT of UGANDA for the Public Works Department, for a probationary period of two years, when, if services are satisfactory, the appointment will be made permanent.

Salary £550, rising to £660 a year by annual increments of £25, payable in the Protectorate in local currency, plus a temporary local allowance of 25 per cent. up to 31st March, 1923, when the arrangement will be subject to review. Outfit allowance of £30 on first appointment. Free quarters and passages. Liberal leave in England on full salary.

Candidates, preferably single, age about 35 years, must have a thorough knowledge of accountancy, preferably with an extensive experience under a large firm of contractors or elsewhere where the duties involve control of expenditure on large buildings and other works of construction. Must be capable of taking the responsibility for the control of all departmental expenditure and collation of the various accounts, the accuracy of all accounts in connection with unallocated stores, checking of cost sheets, &c.

Apply at once, by letter, stating age, qualifications and experience, and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/11,546. 149

The University of Sheffield.

SESSION 1922-23.

Vice-Chancellor: SIR HENRY HADOW, C.B.E., M.A., D.Mus.

DEPARTMENTS of MECHANICAL, ELECTRICAL and CIVIL ENGINEERING, METALLURGY, MINING, FUEL TECHNOLOGY and GLASS TECHNOLOGY.

PROFESSORS.

Mechanical Engineering.—W. RIPPER, C.H., D.Eng., D.Sc., M. Inst. C.E.
Metallurgy.—C. H. DESCH, D.Sc., Ph.D., F.I.C.
Civil Engineering.—J. HUSBAND, F.E.C.Sc.I., M.Eng., Assoc. M. Inst. C.E.
Mining.—D. HAY, B.Sc., Assoc. M. Inst. C.E.
Fuel Technology.—R. V. WHEELER, D.Sc., F.I.C.
Glass Technology.—W. E. S. TURNER, O.B.E., D.Sc., F. Inst. P.
Chemistry.—W. P. WYNNE, D.Sc., F.R.S., F.I.C.
Physics.—S. E. MILNER, D.Sc., F.R.S., F. Inst. P.
Geology.—W. G. FEARNSIDES, M.A.

Electrical Engineering.—E. H. CRAPPER, M. Eng., M.I.E.E. (Lecturer).
Mathematics.—C. A. STEWART, M.A. (Lecturer).

The Courses in the DEPARTMENT of ENGINEERING extend over three or four years and prepare students to become Mechanical, Electrical, Civil, or Mining Engineers, or specialists in Fuel Technology, or Glass Technology.

The Courses in the DEPARTMENT of METALLURGY cover a period of three or four years and prepare students for positions of responsibility either (1) in Iron and Steel Manufacture, or (2) in the Non-ferrous Metallurgical Industries.

The LECTURE COURSES in all the Departments are supplemented by Practical Training in Laboratories and Workshops, which are fully equipped for the purpose of advanced scientific teaching, investigation, and research.

Part-time Courses are arranged for students who desire to take special portions of any of the regular courses.

In Mining Engineering, and in certain of the Courses in Mechanical and Electrical Engineering, and in Glass Technology, arrangements are made to enable students, who come to the University from works or collieries, to take six months' courses of study at the University and six months' practice at the works or colliery each year for a period of four years.

The LECTURE COURSES commence OCTOBER 4th, 1922.

The TECHNICAL LABORATORY COURSES commence SEPTEMBER 26th, 1922.

For further details of the Courses and for particulars of the Degrees, Associateships, Diplomas and Certificates awarded on their successful completion, application should be made to

9097 W. M. GIBBONS, Registrar

PUBLIC NOTICES

University of London, University College.

SESSION 1922-23.

FACULTY OF ENGINEERING.

DEAN: E. G. COKER, M.A., D.Sc., F.R.S., M.Inst.C.E. Professor of Civil and Mechanical Engineering.

THE SESSION BEGINS ON MONDAY, OCTOBER 2nd.

DEGREE AND DIPLOMA COURSES.

Students desirous of entering the Faculty of Engineering with a view to taking a full Degree or Diploma Course must have passed the Matriculation Examination, or some other examination accepted in lieu stead.

SPECIAL COURSES.

Students who have already undergone a partial training elsewhere, and who have attained a sufficient standard, may enter for a course occupying less than three years, and may obtain a General Certificate of Engineering after not less than two consecutive sessions' attendance.

POST-GRADUATE WORK AND RESEARCH.

Graduates in Science or Engineering, or students who have done the work equivalent to a degree, may be admitted to Special Courses of Study, or to prosecute original research.

ENTRANCE SCHOLARSHIP.

A GOLDSMID ENTRANCE SCHOLARSHIP, tenable in the Faculty of Engineering, value £90, will be competed for in September next. Application for entry forms must be made not later than SEPTEMBER 12th.

ADMISSION.

Intending Students should communicate with the Provost forthwith, and send a full statement of their previous training.

EXTENSION OF BUILDINGS.

The new buildings, including the Hawksley Hydraulic Laboratory, the Machine Tools Shop and a new Laboratory for Experimental Work, will be ready for use in October.

Full particulars may be obtained on application to the undersigned.

WALTER W. SETON, Secretary.

University College, London, [Gower-street, W.C. 1] 42

University of Birmingham.

CIVIL ENGINEERING DEPARTMENT.

PROFESSOR: F. C. LEA, D.Sc., M. Inst. C.E., M. Inst. M.E.

COURSES in CIVIL ENGINEERING, including Hydro-electric Engineering, leading to the B.Sc. Degree (exempting from the examinations of the Institution of Civil Engineers), will COMMENCE in OCTOBER.

SPECIAL COURSES are also provided in TOWN-PLANNING and CIVIC DESIGN.

Further particulars can be obtained from the SECRETARY or from the PROFESSOR of CIVIL ENGINEERING. 128

SITUATIONS OPEN

THE WHITECROSS CO., Ltd., Wish to THANK all APPLICANTS for the Post of Technical Assistant. Owing to the large number of applications received only a few selected for personal interview can be replied to. The others are requested to take this as an intimation that their application has not been successful. 158 A

PUBLIC NOTICES

City of Cardiff Education COMMITTEE.

THE TECHNICAL COLLEGE.

PRINCIPAL, CHARLES COLES, B.Sc. (Lond.)

DEPARTMENT OF ENGINEERING.

HEAD OF DEPARTMENT, A. W. LOVERIDGE, B.Sc. (Eng.), A.R.C.Sc.

SESSION 1922-23

(Commencing on TUESDAY, 3rd OCTOBER, 1922).

The following COURSES have been arranged for ENGINEERING STUDENTS :—

A Three Years' Course in Mechanical and Marine Engineering, jointly with the University College of South Wales and Monmouthshire.

A Two Years' Course for Apprentices and others with facilities for practical experience in the Summer Term.

These Courses are suitable for Students preparing for Degrees in Engineering or for the Examinations of the Engineering Societies.

Special Courses are also arranged for Marine Engineers preparing for the Examinations of the Board of Trade.

For further particulars of Full-time and Part-time Courses, Entrance Examination, Scholarships, Fees, &c., apply to the Principal. Forms of application for admission to the Entrance Scholarship Examination, duly completed, must be received by the 18th September.

JOHN J. JACKSON, Director of Education.

City Hall, Cardiff. 51

The Polytechnic, Regent-street, W. 1.

SCHOOL OF ENGINEERING.

PRESIDENT OF SCHOOL: THE HON. SIR CHARLES PARSONS, K.C.B., M.A., LL.D., D.Sc., F.R.S., &c.
HEAD OF DEPARTMENT: ALEX. B. HORNE, O.B.E., B.Sc., (Hon. Eng.), F.R.S. (Edin.), &c.

The DAY DEPARTMENT RE-OPENS on SEPT. 19th. Entrance Examination commences Sept. 12th, at 9.30 o'clock.

Three-year DIPLOMA COURSES in
MECHANICAL ENGINEERING,
ELECTRICAL ENGINEERING,
MOTOR CAR ENGINEERING,
CIVIL ENGINEERING,

Practice in the Laboratories, Drawing-office, Workshop and Field. Fee 21 Guineas per annum.

The EVENING DEPARTMENT RE-OPENS on SEPT. 25th. Students enrolled from Sept. 13th, 6 to 8.30 p.m.

The Day or Evening Courses are recognised for the Diplomas and Certificates issued by the Institution of Mechanical Engineers in conjunction with the Board of Education.

Detailed prospectus of Day or Evening Department, 2d. post paid, from the DIRECTOR OF EDUCATION. 106

The Polytechnic, Regent-street, W. 1.

A SPECIAL COURSE has been arranged for students taking the Graduateship Examination of the Institution of Mechanical Engineers, the Preliminary Examination of the Institution of Civil Engineers, and the Final Examination of the Institution of Electrical Engineers.

The classes are as follows :—

PURE MATHEMATICS	Friday, 6.30-8.0
ENGLISH	Friday, 8.0-9.30
MECHANICS	Thursday, 6.30-8.0
FRENCH	Thursday, 8.0-9.30
PHYSICS	Wednesday, 6.30-9.0

The syllabus covers all the work in these subjects required for the examinations mentioned.

Fee for the Course £2.2s.

Prospectus, 2d. post paid, from the DIRECTOR OF EDUCATION. 147

PUBLIC NOTICES

The Polytechnic, 309, Regent-STREET, W. 1.

A SPECIAL COURSE of LECTURES on "COSTING"

will be delivered by Mr. R. G. LEGGE, A.C.W.A., on FRIDAYS, at 6.30 p.m.,

Commencing 29th September.

(Enrolments begin 13th September.)

Particulars from DIRECTOR OF EDUCATION. 105

Auckland Harbour Board, New ZEALAND.

TENDERS are INVITED for the SUPPLY and DELIVERY of ONE 1-TON FIXED PEDESTAL CRANE for King's Wharf.

Specification, diagram and form of Tender can be obtained at the office of the Board's Agents,

Messrs. W. and A. McARTHUR, Ltd., 18/19, Silk-street, Cripplegate, London, E.C. 2.

on payment of a deposit (returnable) of One Guinea.

Tenders must reach the office of the Board's Agents, addressed as above, not later than Twelve o'clock Noon, Tuesday, 28th November, 1922. 124

East Indian Railway.

The Directors are prepared to receive up to Eleven o'clock a.m. on Wednesday, the 13th September proximo, TENDERS for the SUPPLY of :—

MILD STEEL PLATES.

Copies of the specification can be obtained at the Company's offices on payment of £1 1s. This fee will not be returned.

G. E. LILLIE, Secretary.

73-76, King William-street, London, E.C. 4, 31st August, 1922. 163

State Electricity Commission OF VICTORIA.

TENDERS FOR PLANT.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.

Copies of Tender form and specification will be available upon application to—

Agent-General for Victoria, Melbourne-place, Strand, London, W.C. 2.

SPECIFICATION NO. 282.—COAL-HANDLING PLANT FOR MORWELL POWER STATION AND BRIQUETTING WORKS.

CHARGE.—£2 2s. for the first two copies of Tender form, conditions of contract, specification and drawings complete. These charges will be returned on receipt of a bona fide Tender. A third copy and any further copies will be supplied for the sum of £1 1s. each.

PRELIMINARY DEPOSIT.—A preliminary deposit of £50 is to be lodged with Tender.

The specifications may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 5 p.m., 18th December, 1922.

R. LIDDELOW, Secretary, State Electricity Commission of Victoria, Melbourne, Victoria, Australia. 60

The Great Indian Peninsula RAILWAY COMPANY.

The Directors are prepared to receive TENDERS for the SUPPLY of the following STORES, namely :—

No.		Fee for Specification.
1.	STRAIGHT AXLES (Forgings) and CRANK AXLES (Machined)	10s.
2.	STEEL TYRES for Carriage and Wagons	7s. 6d.
3.	ROLLED STEEL DISC or SPOKE WHEELS and AXLES and AXLES FORGINGS	£1
4.	HELICAL and VOLUTE SPRINGS	£1
5.	LAMINATED SPRINGS	£1
6.	AXLE-BOXES	10s.
7.	WATER CRANES	7s. 6d.
8.	BELLOWS	5s.

Specifications and forms of Tender may be obtained at this office on payment of the fee for the specification, which payment will not be returned.

The fee should accompany any application by post. Cheques and postal orders should be crossed, and made payable to the Great Indian Peninsula Railway Company.

Tenders must be delivered in separate envelopes, sealed and addressed to the undersigned, marked "Tender for Straight Axles," or as the case may be, not later than Eleven o'clock a.m. on Tuesday, the 12th September, 1922.

The Directors do not bind themselves to accept the lowest or any Tender.

R. H. WALPOLE, Secretary.

Company's Offices, 48, Cophall-avenue, E.C. 2. London, 30th August, 1922. 154

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PUBLIC NOTICES

The Bengal and North-Western RAILWAY COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

200 PAIRS WHEELS and AXLES for Carriages and Wagons,

as per specification to be seen at the Company's offices.

Tenders, addressed to the undersigned, and marked "Tender for Wheels and Axles," or as the case may be, are to be lodged not later than Noon on Friday, the 29th day of September, 1922.

For each specification a fee of 10s. will be charged, which cannot under any circumstances be returned.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
E. A. NEVILLE,
Managing Director.

237, Gresham House, Old Broad-street,
London, E.C. 2,
30th August, 1922. 145

The Madras and Southern MAHRATTA RAILWAY CO., LTD.

The Directors are prepared to receive TENDERS for :—

FITTINGS FOR POT SLEEPERS, viz.:
450 TONS WROUGHT IRON TIE BARS.
150 TONS WROUGHT IRON COTTERS.
6 TONS WROUGHT IRON GIBS,

in accordance with the specification, which may be seen at the offices of the Company. The charge for the specification is One Guinea, which will not be returned.

Tenders must be sent in, addressed to the SECRETARY, not later than 2 p.m. on Tuesday, 12th September, 1922, marked "Tender for sleeper Fittings."

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices :
25, Buckingham Palace-road,
Westminster, S.W. 1,
29th August, 1922. 151

The Hull Corporation Electricity Dept. beg to thank the applicants who have applied for the appointments of Combustion Engineer and Personal Technical Assistant, and desires to notify them that these POSITIONS have now been FILLED.

H. BELL,
City Electrical Engineer.
110

East Indian Railway.
ASSISTANT SIGNAL ENGINEER.

The Directors of the East Indian Railway Company are prepared to receive APPLICATIONS (by letter only) from duly qualified candidates for APPOINTMENT as

ASSISTANT SIGNAL ENGINEER

in the Engineering Department of the Company in India.

Candidates should not be less than 25 years of age and should have received a sound scientific education at some recognised Engineering College, and should, in addition, have had some practical experience on one of the leading British railways. They should possess a thorough knowledge of modern signalling practice and be conversant with single and double-line block instruments and modern telephone working.

SALARY.—According to qualifications.

TERMS.—A four years' agreement in the first instance, with first-class free passage to India.

The selected candidate will be required to pass a strict medical examination by the Company's Consulting Physician before appointment.

Letters of application, accompanied by a brief record in chronological order of the applicant's career, with dates (giving details of general and technical education, practical training, and of the signalling schemes upon which he has been engaged), together with copies (not originals) of testimonials, which cannot be returned, should be addressed to the undersigned not later than the 30th September, 1922.

By Order,
G. E. LILLIE,
Secretary.

East Indian Railway Company,
73-76, King William-street,
London, E.C. 4,
30th August, 1922. 150

SITUATIONS OPEN (continued)

WANTED, an ASSISTANT MANAGER for a Large well-equipped Engineering Works in India. Applicants must have had at least 10 years' general engineering workshop experience and have had a public school education; age not to exceed 32. Salary according to qualifications.—Applications, with copies of testimonials, to M., c/o Crossley and Co., Ltd., 8, Racquet-court, Fleet-street, London, E.C. 4. 117 A

WANTED, GENERAL MANAGER for a New Wet Process Cement Plant in India, now in operation; must also be a capable chemist.—State age, experience, and salary required to BAXTED and KNOTT, Ltd., Consulting and Cement Works Engineers, Burnett-avenue, Hull. P5890 A

A NORTH of ENGLAND FIRM, Manufacturing Electrical Lifting, Hauling and Winding Appliances, DESIRES to APPOINT an able and experienced MAN to Take Charge of its Sales Department. Applicants need not necessarily be technically trained, but should have a sound knowledge and wide experience of men-handling in the above productions and understand estimating and negotiating contracts of importance. Gentlemen applying for the position should state age and precise particulars of experience and all information imparted will be treated with the strictest confidence.

Address, "APPLIANCES," Wm. Porteous and Co., Advertising Agents, Glasgow. P5986 A

ENGINEER WANTED as Assistant to Manufacturing Consultant; must have initiative and be well educated, painstaking and accurate with designing ability; works and D.O. (preferably machine tools) experience. Good prospects.—Address, 131, The Engineer Office. 131 A

ENGINEER.—WANTED by a London Engineering concern with works in the provinces, an ENGINEER for a position of responsibility in the works. Applicants must have had first-class practical experience in Electrical Engineering as applied to the manufacture of large types of electrical apparatus, backed up by sound technical knowledge. The position offers scope for the right man, and only those who are really qualified to fill the vacancy should apply. All applications, which will be treated in confidence, should state age, experience and qualifications, positions held, and salary required.—Address, 84, The Engineer Office. 84 A

FIRM in Midlands REQUIRES SERVICES of LEADING DRAUGHTSMAN or ENGINEER, fully versed in the Design of Centrifugal Pumps and Pumping Sets, also in their installation and running, including full knowledge of all electrical conditions involved. Applications (which will be treated confidentially) will only be considered from experienced and educated men of superior engineering type. One with some commercial experience preferred.—Address, stating qualifications, age, salary, &c., 133, The Engineer Office. 133 A

MANAGER REQUIRED for SAW MILL in Tropics. Must have experience in Valuing and Buying standing Timber and understand machinery and processes. Up-to-date know edge of conversion essential. Only thoroughly qualified candidates considered. Salary and commission p.id. Give full details in application.—Address, 118, The Engineer Office. 118 A

MINE ENGINEER REQUIRED, Age 23-28. Must have knowledge of French or Italian.—Apply by letter, with full particulars, to "O.F.," c/o Charles Barker and Sons, Ltd., 31, Budge-row, E.C. 4. 104 A

SITUATIONS OPEN (continued)

REQUIRED IMMEDIATELY, the SERVICES of a GENTLEMAN with a really good connection amongst shipbuilding and repairing yards in the United Kingdom and who is sufficiently well acquainted with the marine superintendent engineers to be able to secure business through his influence in those quarters. Applicants are invited to state fully their qualifications to fill the position satisfactorily, and it is requested that applications shall not be made except by fully qualified gentlemen who are already doing business in the direction indicated. The remuneration and future prospects will depend entirely upon the candidate himself. Interviews will be arranged in London. All information supplied will be treated in strict confidence.—Address, "SHIPBUILDERS," care Deacon's Advertising Offices, Leadenhall-street, London. 97 A

SALES MANAGER WANTED by Flexible Oil Tubing Company. Experience this business essential. State qualifications and salary required.—Address, 155, The Engineer Office. 155 A

TURBINE DESIGNER.—WANTED by a Large London Firm with works in the provinces, an experienced and competent TURBINE DESIGNER. Applicants must have had university or equal training, with actual experience in the design of modern Turbines. None but fully qualified men need apply. Applications (which will be treated in confidence) should state age, experience, qualifications, positions already held, and salary required.—Address, 54, The Engineer Office. 54 A

WANTED, London District, TWO or THREE DRAUGHTSMEN, accustomed to Lay-outs of Plants, Pipe Arrangements, Tank Work, &c.—Address full particulars, age, experience, and salary required, 125, The Engineer Office. 125 A

CHIEF DRAUGHTSMAN, by Large Firm of Constructional Engineers. Must have experience in design and details of all classes of Structural and Bridge Work. Able to make up estimates and control staff draughtsmen.—Address, P6012, The Engineer Office. P6012 A

DRAUGHTSMAN (Good) WANTED, Used to General Engineering; one with some experience in Constructional Work preferred.—Apply by letter, stating age, experience, and salary required, to ROVING ENGINEERING WORKS, Ltd., Stone-on-Trent. 142 A

DRAUGHTSMAN WANTED; Experienced in Designing and detailing all classes of Structural Work and Bridge Work.—Address, stating age, experience, and salary required, 107, The Engineer Office. 107 A

DRAUGHTSMAN WANTED, Senior, Experienced in Centrifugal Pump Design and Plant Lay-out, by an old-established Midlands Firm. State age, experience, and wages.—Address, 130, The Engineer Office. 130 A

FOREMAN MOULDER WANTED AT ONCE, S. Wales district; must be thoroughly accustomed to high-class production in Steel, Iron and Brass; expert knowledge of Machine Moulding essential. The applicant must be a good controller of men and able to obtain production.—Address, stating age, experience, and salary required, 134, The Engineer Office. 134 A

SITUATIONS WANTED

A THOROUGH All-round MECHANICAL ENGINEER, in the capacity of Head Machine Shop Foreman, SEEKS similar APPOINTMENT; good workshop organiser, accustomed to up-to-date methods for both mass production or general engineering and handling large staff. No reasonable offer refused, either home or abroad.—Address, P5966, The Engineer Office. P5966 B

A YOUNG ENGINEER (23), Ex-R.E. Officer, B.Sc., A.C.G.I., 2 years' experience ferro-concrete and steel construction; knowledge French and Russian, energetic, adaptable, SEEKS OPENING with Consulting Engineer, Contractor, or Commercial Firm.—Address, P5990, The Engineer Office. P5990 B

AS WORKS MANAGER, ENGINEER with Sound shop and drawing-office experience in loco., steam, general engineering, millwrighting, ironfoundry and repair work; good organiser, firm and tactful control of labour, thorough knowledge of bonus, lay-out systems and economical production. Excellent long-service references.—Address, P5825, The Engineer Office. P5825 B

BOILER-HOUSE MANAGEMENT.—MECHANICAL ENGINEER (25), experience of boiler testing (Lancashire and water-tube), pyrometry, flue gas analysis, calorimetry, &c., SEEKS OPPORTUNITY under Boiler-house Superintendent to gain further experience, with view to work up for position as assistant.—Address, P6001, The Engineer Office. P6001 B

B.SC. (Edin.), Distinction Civil Engineering, honours all subjects, age 24, 4 years Army, DESIRES first POST, home or abroad.—DALTON, 2, Lee-crescent, Portobello. P5994 B

BUYER.—The MANAGER of a Large Engineering Works Purchasing Dept., who has an exceptionally wide knowledge of the markets of the country, DESIRES to NEGOTIATE NEW APPOINTMENT.—Write, Z. M. 619, c/o Deacon's, Leadenhall-st., E.C. 95 B

CIVIL ENGINEER (B.Eng., Hons., Liverpool), with two years' colonial experience (P.W.D.), REQUIRES POST, either private firm or public body, with good prospects.—Address, P5999, The Engineer Office. P5999 B

ENGINEER (26), Automobile or Mechanical, advanced national diploma with distinction in machine design, associate of a university college, G.I.A.E., privileged apprenticeship, ex-Service, DESIRES POSITION with engineering firm.—Address, P5985, The Engineer Office. P5985 B

ENGINEER (32), Ex-officer, Mechanical and Electrical, DESIRES POST as Maintenance or Assistant Works Engineer; sound shop and D.O. experience in general engineering, repair work, sheet, plate glass, and bottle works.—Address, P5948, The Engineer Office. P5948 B

ENGINEER (35), Good All-round Experience (Fitting, turning, and sea-going), DESIRES CHARGE of SMALL PLANT. Good references.—Address, P6013, The Engineer Office. P6013 B

ENGINEER is DESIROUS of OFFERING His SERVICES as General Manager or Works Manager to any engineering concern which requires a live, up-to-date man, expert in general machine shop practice and construction, foundry and pattern shop. Commercial and works routine.—Address, 161, The Engineer Office. 161 B

ENGINEER, Late Manager Small London Works, E. 30 years' experience of general engineering, SEEKS any responsible POST. Moderate salary, good references.—Address, P6008, The Engineer Office. P6008 B

ENGINEER, Mechanical and Electrical (27), a Years practical, 3 years technical, sound knowledge of all classes of steam and internal combustion engines, constructional and general engineering, D.O. routine, DESIRES POSITION with Consulting Engineer or as Assistant in Works, home or abroad. Excellent testimonials.—Address, P5963, The Engineer Office. P5963 B

ENGINEER TESTER REQUIRES CHANGE; 16 years chief tester for large firm of turbine pump manufacturers, experienced in all kinds of pumps, electrical, Watsons, &c.—FARROW, 26, Sherwood-street, Reading. P5760 B

SITUATIONS WANTED (continued)

ENGINEERS' RATE-FIXER DISENGAGED. Thoroughly experienced in modern productive methods, planning, progressing, speed and feed demonstrating, or as machine shop foreman.—Address, P6011, The Engineer Office. P6011 B

ENGINEERING EMPLOYERS

DESIROUS OF
OBTAINING THE SERVICES OF

EXPERIENCED & QUALIFIED FOREMEN,

having export knowledge and supervisory abilities, should address 9090, The Engineer Office. 9090 B

EX-SERVICE MECHANICAL ENGINEER, with 12½ years' experience in general fitting and turning (excluding 4½ years' service in R.F.A., repairing guns and wagons), also special knowledge of mineral water machinery, SEEKS SITUATION.—Address, S. WHITE, Fern Lodge, Streatham Common North, S.W. 16. 135 B

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For continuation of Small Advertisements see page 3.

AUGUST.

Gliders.

THE poor results obtained at the glider trials at Combegrasse, near Clermont-Ferrand and the remarkable flights of more than two hours' duration effected by Hentzen with a gliding apparatus in Germany tend to show that while little can be done with indiscriminate experiments, there is much to be hoped for in the scientific study of planes which depend for motive power upon the action of wind currents. The French competitors did nothing that could not be accomplished by a skilled pilot with an aeroplane from which the engine has been removed. In fact, some of the best glides were made in this way. No one succeeded in utilising wind pressure for flying at varying altitudes, and the only positive result of the trials was to show their value as a means of testing the forms of planes. In view of these failures it did not appear possible to develop non-mechanical flight into a practical art, for the reason that there is no human instinct that will enable a pilot to utilise forces over which he can have no control whatever. Those forces are invisible and essentially variable, and, once in the air, the pilot has at present no means of judging of their velocity and direction. All that the French experimenters could do was to keep on gliding until they could discover the knack of flight. Events proved that this method of solving the problem of flight was not without serious danger, one man being killed and others more or less seriously injured. While the French trials were still in progress the German pilot made an actual flight of more than two hours, which has since been surpassed by another flight of three hours. It is asserted that those flights must have been made under conditions of constant wind pressure from one direction. Even then the feats mark a considerable progress in flight, and suggest that a great deal more may be expected from the new science of aerodynamics. So far as is known of the conditions under which the German flights were carried out, they show that the problem has only been solved within a limited range. The experimental application of aerodynamics to gliders may give increasingly better results in the future; but obviously we have not yet reached a stage when air gliding can be regarded as a desirable sport, and it must pass through a long period of experiment before gliding flight can become an accomplished art.

The Whitworth Scholarships.

THE new regulations issued by the Board of Education, which will govern the awarding of Whitworth Scholarships in 1923, embody some important changes. These changes have been introduced in order to render the requirements prescribed as to the candidates' practical experience in handicraft more consistent with the present arrangements for apprenticeship and training in mechanical engineering, and the competitive examination more in keeping with the courses now followed. The Board states that the experience of recent years has shown that candidates for Whitworth Scholarships may be divided into two groups: (*a*) a larger group of candidates, whose education after leaving school has been confined to part-time courses of study, and for whom a full-time course of study at a university or technical institution is likely to be suitable; and (*b*) a smaller group of students who have already completed a full-time course of study at a university or elsewhere and can with advantage take a further post-graduate course. Under the new regulations it is proposed to offer to candidates of the first type, who must be less than twenty-one years of age, six Whitworth Scholarships, having an annual value of £125 and tenable for three years; while two Whitworth Scholarships of an annual value of £250 and tenable for two years will be open to candidates of the second class, the age limit in this case being extended to the twenty-sixth year. The thirty Whitworth Exhibitions of £50, tenable for one year, will be discontinued; but the Board proposes to offer annually twenty-five Whitworth Prizes to the value of £10 each on the result of the examination for Whitworth Scholarships. The regulations governing the qualifications of a candidate for a Whitworth Scholarship require that the candidate must have been engaged in handicraft in a mechanical engineering workshop for a period of at least thirty months. It is further required that the candidate must submit for examination his certified laboratory notebooks relating to practical work of a standard appropriate to the examination in the competition for which he has entered. This regulation would seem to debar candidates whose practical training is satisfactory, but who may have prepared for the examination by private study. The Board desires, however, to make it clear that the new regulations in their present form are regarded as experimental, and the Board will be glad to receive further criticisms and suggestions that may be offered and to consider them in connection with the revision of the regulations for 1924.

A Fatal Railway Accident.

THE second fatality this year to a passenger in a train accident—the first was at Blisworth on Jan. 27th—occurred on the morning of the 21st of the month at the Milton Range halt between Gravesend and Hoo Junction—the signal-box for the Port Victoria branch—on the South-Eastern and Chatham main line to Maidstone. During a fog that prevailed a down workmen's train overshot the halt, and the workmen who alighted passed, as was their custom, in front of the engine, and then had to walk back the length of some half-dozen coaches on the up line in order to reach an occupation crossing, where they passed off the railway. Whilst walking along the up line the men had their backs to the traffic, and evidently did not hear the approach of a light engine, which knocked some of them down, fatally injuring two of them. Meanwhile a second workmen's train arrived at Gravesend. In order to get all the train to the platform it was necessary to lower the starting signal. Rule 45 (*a*) applies to the conditions prevailing, and it says that where there is an advanced starting signal the starting signal must not be lowered until the train is close to it and has been brought quite, or nearly, to a stand. This rule the signalman at Gravesend told Major Hall at the Ministry of Transport inquiry on the 24th he did not obey, but he kept his advanced starting signal on. When the driver was given a hand signal to start he went ahead. He did not see the advance signal, but his fireman said he did, and that it was "off." As the first train had been delayed picking up the injured men at Milton Range, the signalman at Hoo Junction had not sent "train out of section," for it, nor, therefore, had Gravesend, offered the second train to Hoo Junction, and until it had been offered and accepted the advanced starting signal at Gravesend should not have been lowered. The signalman, however, said that it was "on." The second train thus entered a section already occupied, and ran into the standing train, killing one passenger.

A Large French Wireless Station.

ON August 17th the new Transcontinental wireless station of Sainte Assise, known as Paris Radio Central, was formally opened. The foundation stone was laid on January 9th, 1921, whilst on July 4th of this year the first message was transmitted to America on a wave length of 14,300 m. During the afternoon Senatore Marconi, who was then on his yacht Elettra in the neighbourhood of New York, reported excellent signals, and after more detailed observations a further telegram of congratulations was sent by Senatore Marconi on the following day. Hitherto the wireless station of Croix d'Hins, near Bordeaux, has held the distinction of being the most powerful station in the world, but the new Sainte Assise station is about twice as powerful. The area covered by the station is bounded on the north side by the road from Seine Port to Sainte Leu, on the south and west by the Seine, and on the east by the railway connecting Melun and Brunoy. Inside the two buildings which constitute the station there are two 5-kilowatt valve transmitters which serve for the short distance communications, four high-frequency 28-kilowatt alternators for European services, and two 500-kilowatt and two 250-kilowatt alternators for the long-distance or "International transmissions." The valve transmitters work on aerials supported on towers 330ft. high, whilst the 25-kilowatt alternators which deal with the continental messages operate in conjunction with a double-cone aerial which is 830ft. high. The aerial for the International communications is supported at the same height by sixteen towers, and consists of a double network. Power for operating the installation can either be drawn from the local supply system or from a Diesel engine plant which has been put down for use in the case of emergency. Each of the transmitting equipments can handle traffic at the rate of 100 words per minute, and when the entire plant is in operation it will be possible to send no fewer than 36,000 words per hour.

The Eastern Railway Group.

TERMS for the constitution of the Eastern Group of railways were announced on the 3rd. The constituent companies of this group are the Great Central, Great Eastern, Great Northern, Hull and Barnsley, North-Eastern, Great North of Scotland, and North British. The Hull and Barnsley has already been amalgamated with the North-Eastern. The last-named company has been the prime mover in arranging the terms, which must have presented a very difficult task, as certain of the companies had many varieties of stocks, some of which were of little value. To the engineer the vast size of the property under the control of this group will appeal—possibly with some misgiving as to the result. The group will be responsible for two hundred and thirty million pounds on which a dividend has to be paid, and it will spend in wages, material, coal, stores, &c. about eighty millions a year. It will possess twelve thousand miles of running line, or 37.79 per cent. of all in Great Britain, and have over seven thousand engines, or 31.2 per cent. The constituent companies have eleven manufacturing and repairing centres, and a problem which will confront the new group, and one in which labour will be deeply interested, is which of them shall be closed. The Eastern Group will command every port between the Thames and the Forth except Goole, which belongs to the North-Western and Midland Group. With the Great Eastern and Great Central steamers it will have a fine fleet. The North-Eastern has no steamers of its own, but it has £82,500 invested in Wilson's and N.E.R. Shipping Company, Limited. What will make the Eastern Group so strong is its direct access to Manchester, Liverpool, Oldham, Wigan, and other parts of Lancashire by means of the Great Central, and its access to Glasgow *viâ* the North British.

Liner Accidents.

DURING the month we have had occasion to refer in our Seven-day Journal to various accidents on Atlantic liners, which, although, in some cases, they increased the length of the voyage and often necessitated altered sailing arrangements, were not, save in the case of the White Star liner Adriatic, associated with loss of life. The explosion on the Adriatic, which took place in the early morning of August 11th, was unhappily the cause of five deaths. It occurred in a reserve coal bunker in the lower hold, and although the cause is not exactly known, it is supposed to have taken place during the fixing of an electric light cable in that compartment. On August 23rd the Olympic resumed her sailings from Southampton. It will be remembered that on her last inward voyage after a record speed run it was found that her stern post was fractured. The vessel was dry-docked and the damage repaired by electric welding, this work being carried out by Harland and Wolff. A smart piece of repair work was done on Monday, August 21st, when the Cunard liner Berengaria was dry-docked in twenty-eight minutes and one of her port propellers removed and replaced with a new one. Apparently the Berengaria had come in contact with some submerged obstacle, which not only broke off a propeller blade, but also slightly bent the rudder frame. The repairs were effected by John I. Thornycroft, Limited. On her last outward voyage it was reported that the White Star liner Majestic had been delayed by engine trouble, and that repairs had been carried out by the engine-room staff at sea. The exact cause of the trouble has not as yet been announced, but the Majestic left New York on Saturday, the 26th, and between noon on Sunday and noon on Monday she steamed—so we are informed—at the rate of 24.65 knots. This satisfactory performance would seem to show that her machinery is again running well.

Fuel Economies.

FURTHER trials carried out in France during the past month with suction gas as a motive power for commercial road vehicles and tractors formed part of a comprehensive programme of research into the utilisation of cheap fuels that has already given practical results. The object of the French is to reduce the huge sums of money that are paid every year for imported coal and oils. They believe that they will be able eventually to satisfy the whole of their requirements with home-produced fuels. So far as petrol is concerned, the only substitutes that are likely to reduce the burden of payments for foreign supplies are suction gas and alcohol, and although it has been proved that great economies can be realised with suction gas plants using charcoal or wood as fuel on commercial vehicles, there is much yet to be elucidated in the way of charges and maintenance costs before it can be positively asserted that suction gas will replace petrol in heavy vehicles. It is, at all events, one of the most promising solutions of the problem yet offered. In the case of alcohol the production is only one-tenth of the total amount of petrol imported, and its employment can therefore only be a palliation, while the presence of 1 per cent. of water in alcohol necessitates dehydration before mixing with the mineral spirit. At present a mixture of alcohol and benzol is the only satisfactory fuel with an alcohol basis, except the combination with other and

other constituents, which is largely used in the Colonies. Of more immediate practical effect is the investigation of the French Commission on the Utilisation of Fuels, which has just issued its final report, and deals with the various methods by which the consumption of fuel can be economised for steam raising. In many of the big engineering works the saving effected in the quantity of coal consumed has been from 10 to 13 per cent. While this means a very large total economy and an appreciable saving to the country, it does not appear as if this long and very exhaustive investigation will hold out any hope of France being able to dispense with foreign coal. The only chance of eliminating foreign fuel lies in the national electrification scheme, which, however, is is not likely to be completed for a great many years.

Naval Losses.

ON the evening of Tuesday, August 8th, while cruising off the Labrador coast, the light cruiser H.M.S. Raleigh, the flagship of Admiral Sir William C. Pakemen, went seriously aground in fog at Point Amour, in the Straits of Belle Isle. From the reports received we learn that the vessel is badly damaged, with her engine-rooms flooded and a large hole in her tanks. With the tides prevailing and taking into account her dangerous position, it is feared that she may become a total wreck; but, on the other hand, it has been reported that she may eventually be salvaged. In an attempt to reach the rocky coast and establish a life-line connection eleven men were drowned, and only the officer in command reached the rock cliffs, whence communication was established and the ship's complement safely transferred to land after three hours of strenuous labour. The crew has since been repatriated. The Raleigh, which was only put into commission last year, was built and engined by William Beardmore at Dalmuir and completed at Devonport Dockyard. She has a displacement of over 10,000 tons and is equipped with Brown-Curtis turbines developing about 65,000 horse-power and giving a speed of 30 knots. The boilers are arranged for oil burning, but four small coal-burning boilers provide sufficient for cruising speeds. The French Navy has sustained a severe loss through the sinking of the battleship France, which, when returning from gun practice with the Mediterranean Squadron, struck an uncharted rock at the entrance to Quiberon, off the Breton coast, and foundered three hours later. The accident occurred on Friday evening, the 28th ult., as the vessel was passing through the Teignouse Channel. Happily, it was possible to transfer the complete ship's complement to other vessels, and only one casualty is reported, which was probably caused by the first inrush of water into the boiler-rooms. The wreck of the France is partly uncovered at low tide, and an examination has been made to ascertain the possibility of salving the ship. It is considered very doubtful, however, whether the vessel can be re-floated.

Railway Accidents.

WHILE the French railway companies are adopting automatic devices for preventing trains from passing signals against them, and are even experimenting with a system which ensures trains running automatically in accordance with the signals, it is significant that several accidents took place during the month that could not have been avoided by any method of mechanical or electrical control. By far the most serious was the failure of the compressed air brakes on a train which was unable to reach the top of a gradient at Miélan, near Tarbes. The driving wheels slipped on greasy rails and the train ran backwards, gathering momentum until it smashed into another train which had been stopped. The rear van and two coaches were demolished, involving great loss of life. In another case, also on the Midi, an express was travelling at high speed when some coaches turned over, through, it is said, a broken rail. The passengers fortunately escaped with slight injuries. On the Ouest-Etat line a boiler slipped off a truck near Bonnières and blocked the line, damaging a signal, which was jerked into the "reduced speed" position. A train approaching on the other line happily slowed down, and the collision with the boiler did not cause any considerable damage. All these accidents appear to have been unavoidable, except so far as concerns a want of previous care, and were certainly lessened in their effects in some cases by the initiative of the drivers. These examples show that the most perfect systems of automatic control will not prevent disasters, although they will do much to ensure safety in railway travelling, and as there are possibilities of accidents beyond the control of automatic devices it follows that the use of such systems should not be allowed to stifle the spirit of prompt initiative and resource amongst those responsible for the running of trains.

The Kelham Beet Sugar Factory.

No. III.*

TREATMENT OF THE BEET.

THE beet flume from the silos, on entering the factory building passes first of all through a control pit and then to a sump into which dips the lower rim of a large wheel—28ft. in diameter—which is revolved by means of toothed gearing. The wheel, a view of the back of which is given in Fig. 19, is

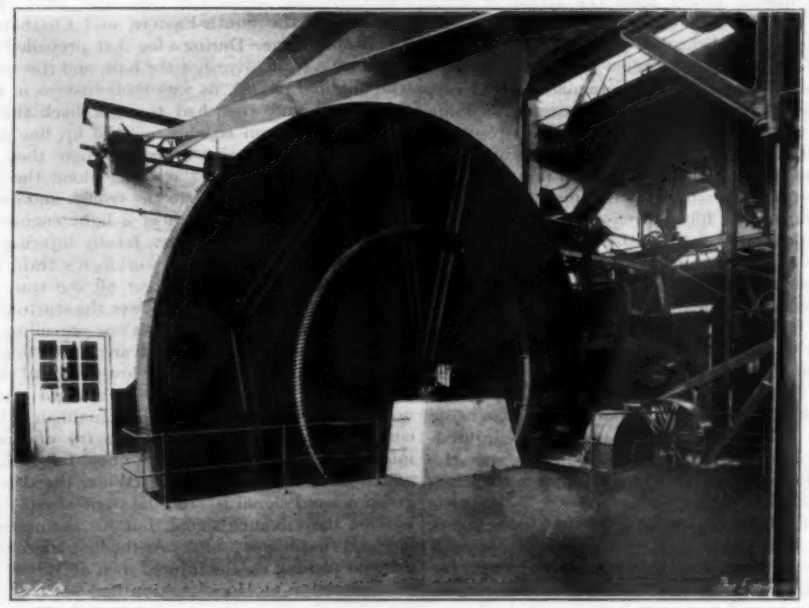


FIG. 19—REAR VIEW OF THE BEET ELEVATING WHEEL

built up of steel plates and its periphery, which also consists of steel plates, has arranged inside it a series of buckets spaced at equal intervals all round. As the wheel revolves, the beet-roots are picked up by the buckets, which are perforated so that the water may escape. During the journey from the silos, and in being lifted by the wheel, the roots undergo a certain amount of washing, but they are by no means clean. They are therefore delivered from the upper part of the wheel, as it revolves, on to an inclined shoot down which they slide into a washing tank, which is some 18ft. long by 6ft. wide, and through which a stream of water is always flowing. The tank has a perforated false bottom so that the dirt washed from the beet may pass away. Arranged in the length of the tank is a horizontal shaft, which is carried in five bearings, and which is furnished with a series of arms so shaped that they turn the roots over and over in the water and gradually move them along to the far end of the tank. When they arrive there they are quite clean, and a specially formed set of arms lifts and discharges them over the side of the washing tank to a herb and stone extractor, from which they are lifted by a worm conveyor to a horizontal jigging conveyor. The delivery from the jigging conveyor is into the boot of a bucket elevator—see Fig. 29, page 213—by which the roots are lifted to the top of the building, where they are discharged into the hopper of an automatic weighing machine, which is capable of taking 400 kilos.—say, 882 lb.—per charge.

THE DIFFUSION PROCESS.

The weighed charge of beet is then dropped into a hopper, from the bottom of which two sets of worm gear feed the beet to the slicing machines, of which there are two, and in which the roots are cut into what are technically termed *cosettes*. The knives of the slicers or cutters have serrated cutting edges, so that the *cosettes* are shaped as shown in the accompanying sketch. From the cutters the *cosettes* pass

into the trough of a horizontal worm conveyor, the bottom of which has four discharge openings spaced at equal intervals in its length, each of which is furnished with a revolving discharge shoot. On a floor immediately below are two rows of seven diffusers, which are vertical vessels with conical ends at top and bottom, both of which are furnished with hinged covers, which, when closed, can be tightly clamped by nuts. The *cosette* conveyor runs horizontally immediately above the central space between the two rows of diffusers, and the shoots from the trough are so situated that the *cosettes* can be delivered into any one of the diffusers at will. Gates are fitted

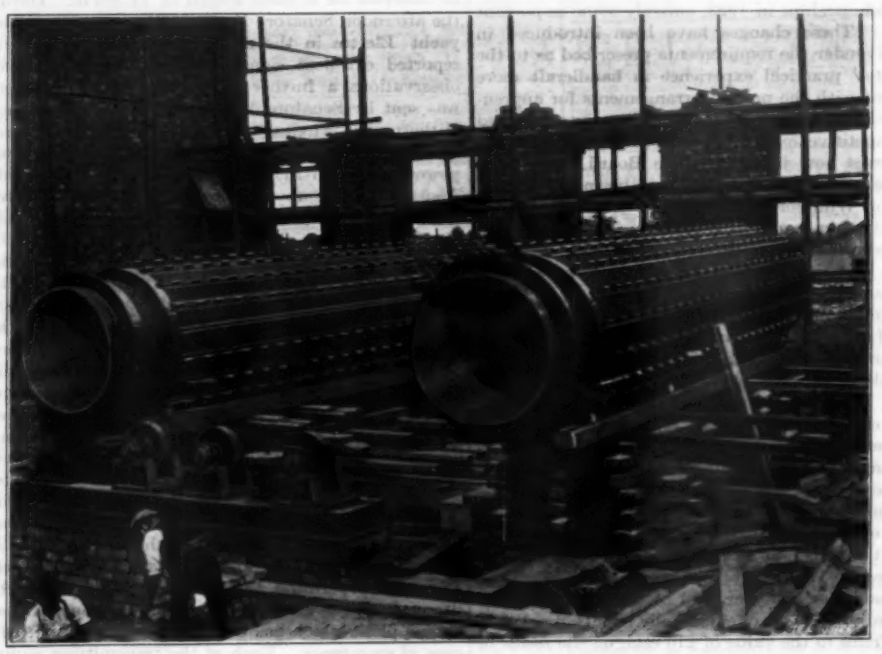


FIG. 20—PULP DRYING CYLINDERS BEING PLACED IN POSITION

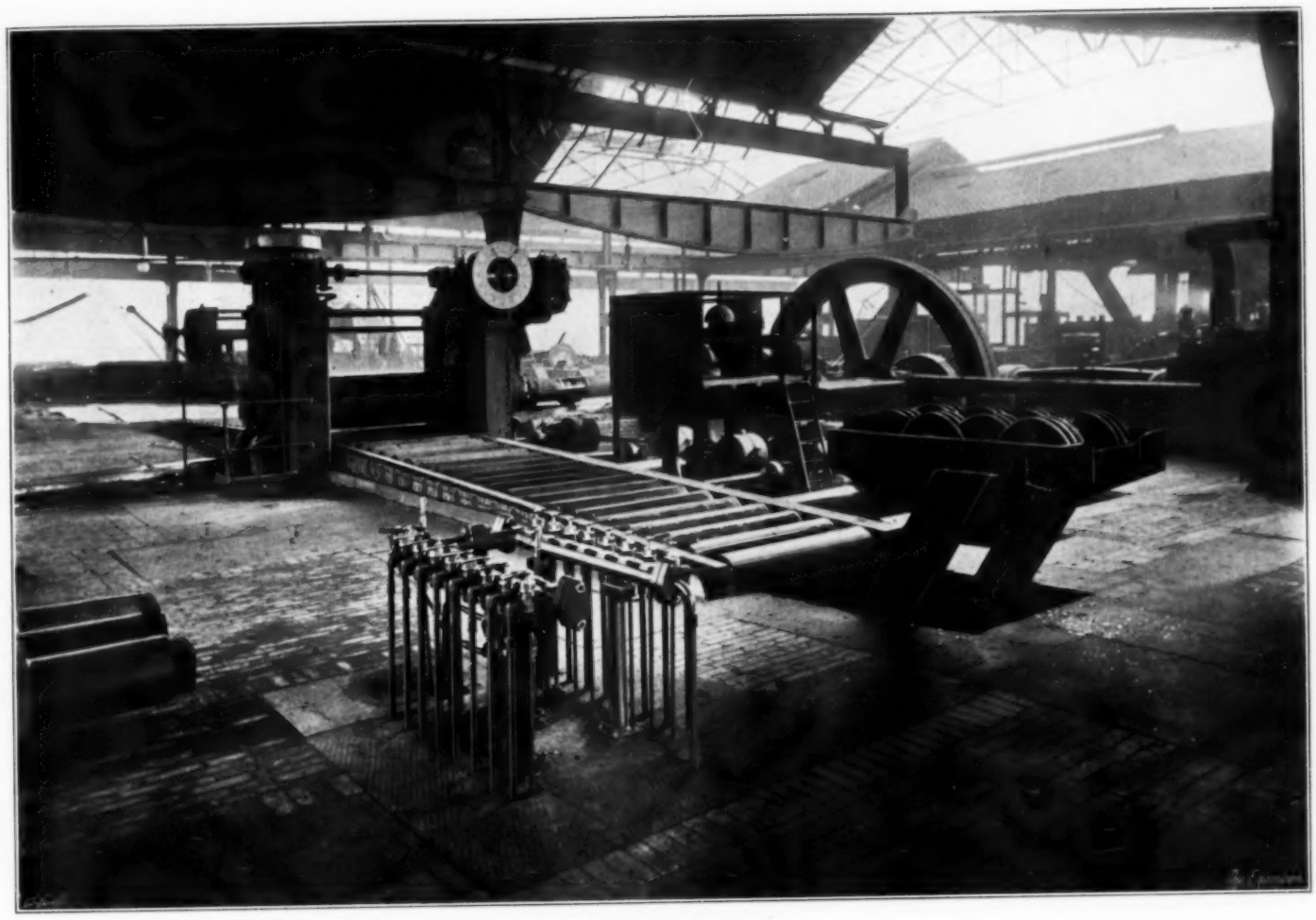
* No. II. appeared August 25th.

THE PARK GATE IRONWORKS

60-TON SIEMENS FURNACE—CHARGING SIDE

400-TON MIXER—CHARGING SIDE

WORKS, NEAR ROTHERHAM



28-INCH THREE-HIGH PLATE MILL

400-TON MIXER—SLAGGING SIDE

to each shoot so that the supply of *cosettes* can be cut off when it is desired. When a diffuser is full its cover is closed and screwed tightly down. The diffusers are so coupled up with piping that they are always in series with one another, and so that the liquid passes from one to the other; yet they are not always in the same order in the series, for a diffuser, when newly charged, is arranged last in the series, the one which had been charged just before it immediately preceding it, and so on. The liquid as it issues from one diffuser to the next passes through a heater operated by exhaust steam from the engines, and as it passes from vessel to vessel it meets fresher and fresher *cosettes* each time, thus steadily increasing in density as it proceeds from one diffuser to the next. When finally withdrawn the juice is a bluish-black semi-opaque liquid. A view looking down on the battery of diffusers is given in Fig. 21.

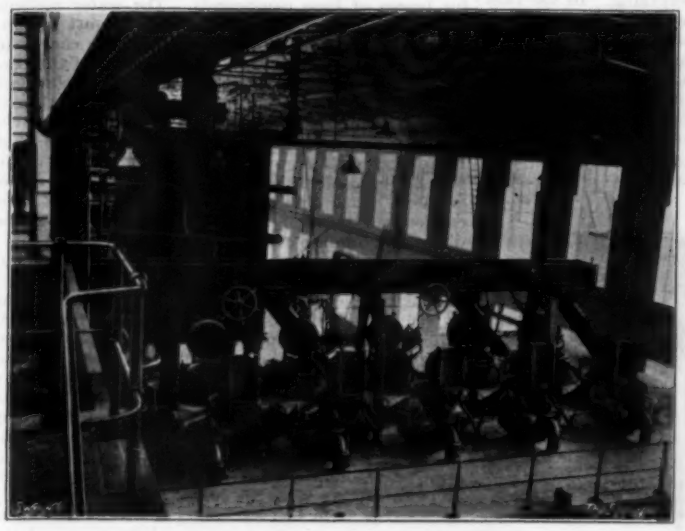


FIG. 21—BATTERIES OF DIFFUSERS

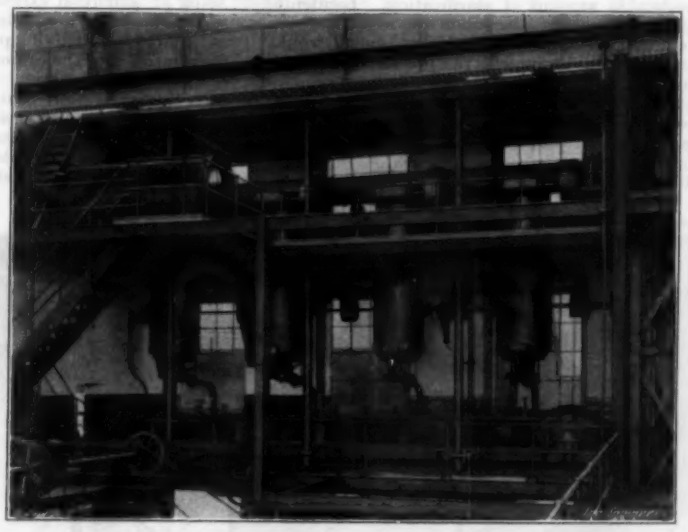


FIG. 22—FIRST SET OF PULP PRESSES

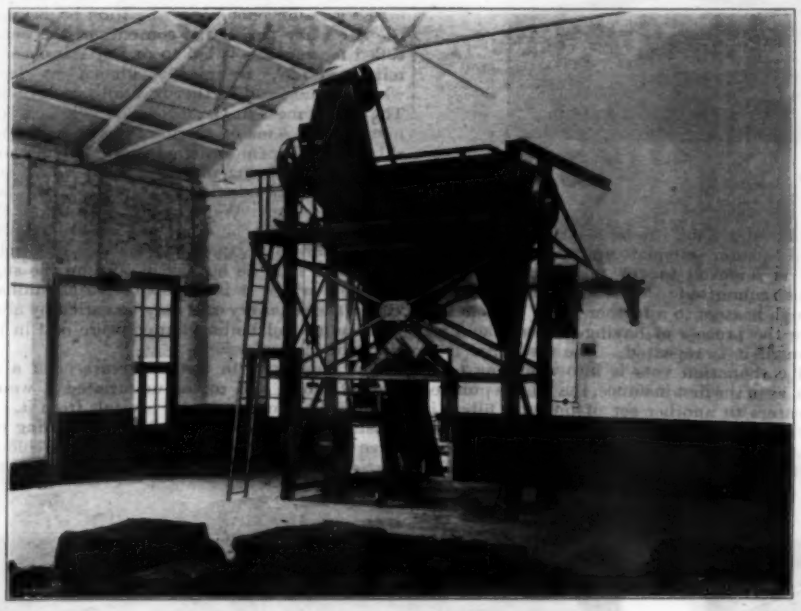


FIG. 23—SUGAR WEIGHER AND SACKER

TREATMENT OF THE SPENT "COSETTES."

Before we discuss what becomes of the juice thereafter we may conveniently here say what becomes of the spent *cosettes*. When the juice from a diffuser has been drawn off, the bottom cover is opened downwards, and the spent *cosettes*, then termed pulp, are deposited into a pulp tank, whence they are lifted by means of a pump to a trough in a gallery, where the free water leaves them. They are then fed by worm conveyors to a series of four presses—see Fig. 22—in which a certain amount of their suspended moisture is squeezed out. After being discharged from those presses they are led by conveyor to an adjoining room, where they are treated in a further series of six presses of a somewhat different type, being thereafter passed into a mixing trough, where a certain proportion of the molasses obtained at a later stage of sugar manufacture is added. The mingled pulp and molasses are then taken to a dryer, which consists of two steel cylinders through which hot gases are passed. Fig. 20 shows the two cylinders while they were being got into position, and Fig. 24 shows the completed pulp drying room. The gases partly come from the furnaces of the main boilers, as explained above, and partly from two supplementary furnaces which adjoin the dryer. The molasses-treated pulp, on leaving the dryer, contains practically no moisture, and it is taken by conveyor into the dried pulp store near by, where it is bagged for dispatch as cattle food.

CLARIFYING THE JUICE.

Returning now to the juice from the diffusers, it may be explained that, as each diffuser is emptied, its fluid contents are pumped into a circular measuring tank into which is poured a definite quantity of milk of lime. The mixture flows to mixing tanks, which are furnished with mechanically operated stirrers, from which it is lifted through heaters to carbonating—or, as the French call them, "carbonatation," a word which has apparently found its way into the English "sugar" dictionary—vessels, wherein it has carbon dioxide gas pumped through it. The result

FIG. 24—THE PULP DRYING ROOM

FIG. 25—THE MACHINERY HALL FROM THE DIFFUSER PLATFORM

is that the hydrate of lime is converted into insoluble calcium carbonate, which tends to sink to the bottom and to carry with it much of the impurities and solids contained in the juice, and, hence, brings about a considerable amount of clarification. Incidentally, it may be remarked, the solids and other impurities, which are precipitated in this manner, would if allowed to remain, impede the process of crystallisation, and that the treatment with lime renders it much more easy to separate them from the juice by subsequent filtration than would otherwise be the case. A view of the two carbonating vats is given in Fig. 27.

Both the lime and the carbon dioxide gas are manufactured on the site. For the purpose a special vertical kiln made of steel plate and lined with refractory material has been provided. The top of the kiln is over 50ft. from the ground, and the raw materials, limestone and coke, are lifted to the charging platform by means of a bucket elevator, the stone having previously been passed through a crusher. The two products of the kiln—lime and carbon dioxide gas—are both, as we have shown above, employed in a sugar factory. There is no means of storing the gas. It is simply passed through a washer and pumped direct into the carbonation tanks by means of a horizontal pump which is worked by a prolongation of the tail rod of a Corliss engine, which, as explained above, also drives a vacuum pump. The lime is slaked in two circular steel tanks arranged at ground level near the base of the kiln, and furnished with mechanically operated revolving stirrers. A view of the lime kiln is given in Fig. 30, page 213.

It may be wondered why there should be no means of storing the carbonic acid gas which is produced during the burning of the lime, but it must be remembered that a sugar "campaign," unless some breakdown occurs, proceeds continuously without a stop from the time it starts till all the available beet has been dealt with. All the machinery is constantly in operation, and the object aimed at in the design of a factory is so to proportion all its component parts that there is enough of everything to "go round"—if such an expression be permitted—without there being an abnormal excess of anything. In the case of the lime kiln, if a little more gas is produced than is required for clarifying purposes, it is simply allowed to blow off into the atmosphere.

From the carbonation—or carbonatation—tanks or vats the liquid flows into a mixing tank, from which it is pumped through heaters to a first series of filter presses. The latter consist of a number of steel frames, having filter cloths stretched over them, arranged side by side and clamped together by long-screwed bolts and nuts. A large proportion of the precipitated calcium carbonate and with it impurities and solids is removed in the first filters, and the filtrate is then submitted to a further liming and passed again through heaters to a further set of carbonation vats, where the process of having carbonic acid gas blown through it is repeated. The discharge from the second carbonation vats is into a mixing tank, from which, as in the first instance, the juice is pumped through heaters to another set of pressure filters in which the filtering cloths are of finer mesh than in the first series. Even this second filtration is not considered sufficient, for after a further heating the juice is passed through a third set of filters the frames of which are furnished with even finer cloths than the others. The liquid discharged from these last filters is quite clear and white, having lost all its dark colour and opacity. The deposit left in the filters is composed largely of calcium carbonate in a fine state of subdivision, and has a ready sale for agricultural purposes. Before the deposit is removed from the presses hot water is pumped through the latter—in the same direction as was the juice—so as to remove the last traces of sugar-carrying juice which may remain in the pores of the deposit. A view of a portion of the filter equipment is given in Fig. 28.

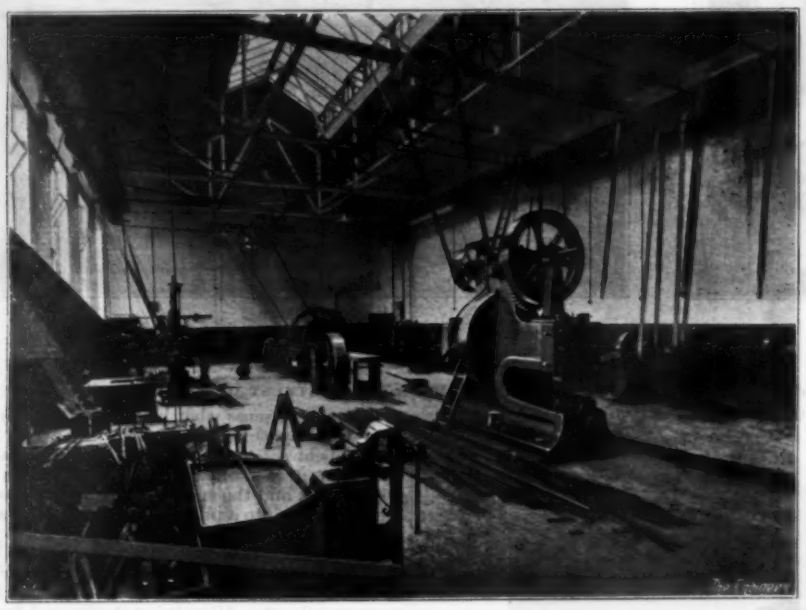


FIG. 26—THE REPAIR SHOP

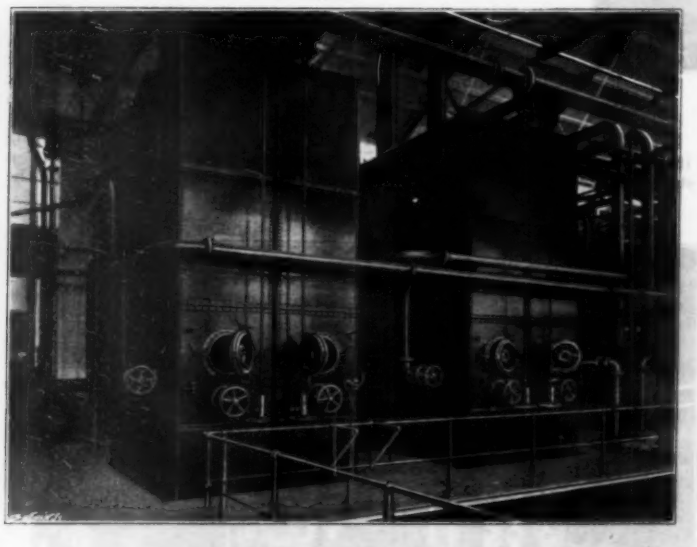


FIG. 27—THE CARBONATING TANKS

FIG. 28—SOME OF THE FILTER PRESSES

TURNING THE JUICE INTO SYRUP.

On leaving the third set of filters the juice—then known as "purified thin juice"—is simply a dilute solution of sugar and water, practically pure saving for traces of lime compounds. The water content may be as high as 88 per cent., and it must be considerably reduced before crystallisation can take place. The first process in the reduction of the percentage of water is carried out in a quintuple-effect evaporator, a view of which, taken during erection, is reproduced in Fig. 31, page 213, and which receives its steam not only direct from the boilers, but from the exhaust of various heating units in the factory. The exhaust from the evaporators is dealt with in a barometric condenser, the condensate being returned to the boilers. The discharge from the evaporators is known as "syrup," the proportion of water having been reduced to about 40 per cent. In order now to remove the last traces of the lime compounds and any other remaining impurities the syrup is subjected to what is known as sulphitation. In some factories the sulphitation is effected by the addition of liquid sulphuric acid, but at Kelham the syrup, after being passed through a heater, is allowed to fall in a cascade through an atmosphere of sulphurous acid gas created by burning ordinary stick sulphur in a closed chamber. The syrup then, after passing through a further heater, is pumped through a final set of filters, from which it emerges as "pure virgin syrup." It is then ready for treatment in the vacuum pans, of which there are two, and which are exhausted by means of the vacuum pump mentioned earlier in this article as being driven by the Corliss engine, which also operates the CO_2 gas pump. A view of the two vacuum pans taken during erection is given in Fig. 32, page 213.

CRYSTALLISATION.

During the process of boiling under low pressure in the vacuum pans, crystallisation begins, and after the necessary period the contents of the pans—then called *massecuite*—is led to one or the other of long mixing tanks, technically known as *malaxeurs*, where cooling and further crystallisation takes place. The sticky mass in the *malaxeurs* is kept in constant motion by means of stirring arms shaped not unlike ships' propellers and carried on a revolving horizontal shaft. The stirring materially assists the formation of crystals and augments the sugar extraction from the *massecuite*. We may here mention that the object of boiling the syrup under vacuum is that the temperature of evaporation may be reduced and so that there may be no risk of turning the sugar into caramel—which it is impossible to crystallise. The size of the sugar crystals may be varied by alterations in vacuum and boiling temperature and in the time spent in the *malaxeurs*.

The *massecuite* in the *malaxeurs* is of a reddish-brown colour, and to the uninitiated it would seem impossible to obtain white crystals from it. Yet the crystals in it are white, if all the preceding processes have been properly performed, and the colour of the *massecuite* is only due to the thick syrup which contains them. The separation of one from the other is done in the centrifugals, and it is of interest to note that the centrifugals at Kelham are among the few British-made machines in the whole factory. They were made by Watson, Laidlaw and Co., Limited, of Glasgow, and are hydraulically driven, the pressure water being obtained from a pump near by. There are in all eight centrifugals, six being known as "first jet," and two as "second jet." A dose of *massecuite* is fed into each of the six "first jet" centrifugals in turn, and after the machines have been revolved quite a short time—a matter of a few minutes for each operation—the liquid is all expelled by cen-

THE KELHAM BEET SUGAR FACTORY

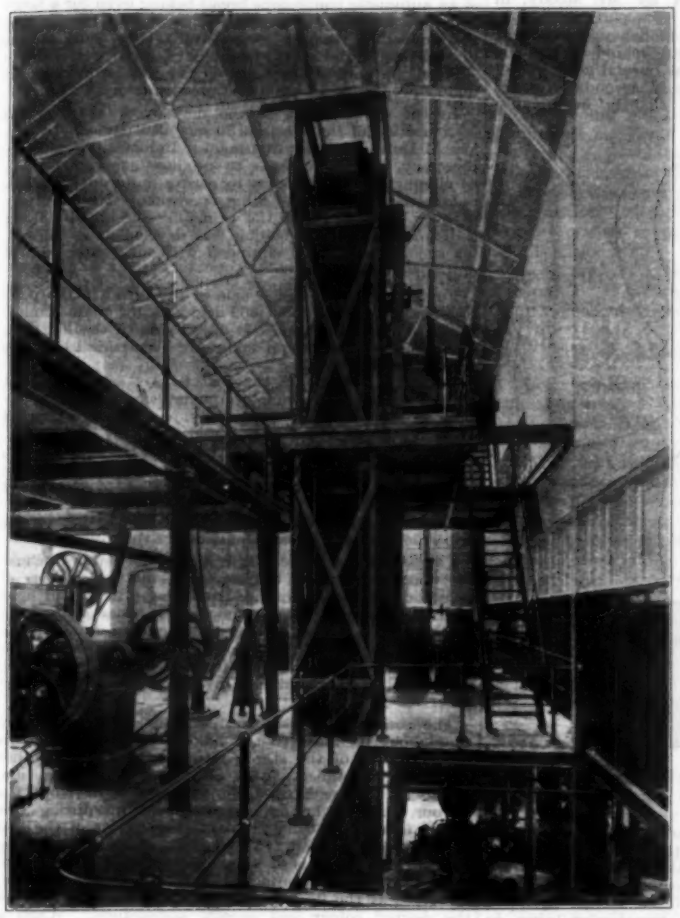


FIG. 29—THE BEET ELEVATOR

FIG. 30—THE LIME KILN

FIG. 31—QUINTUPLE EFFECT EVAPORATOR

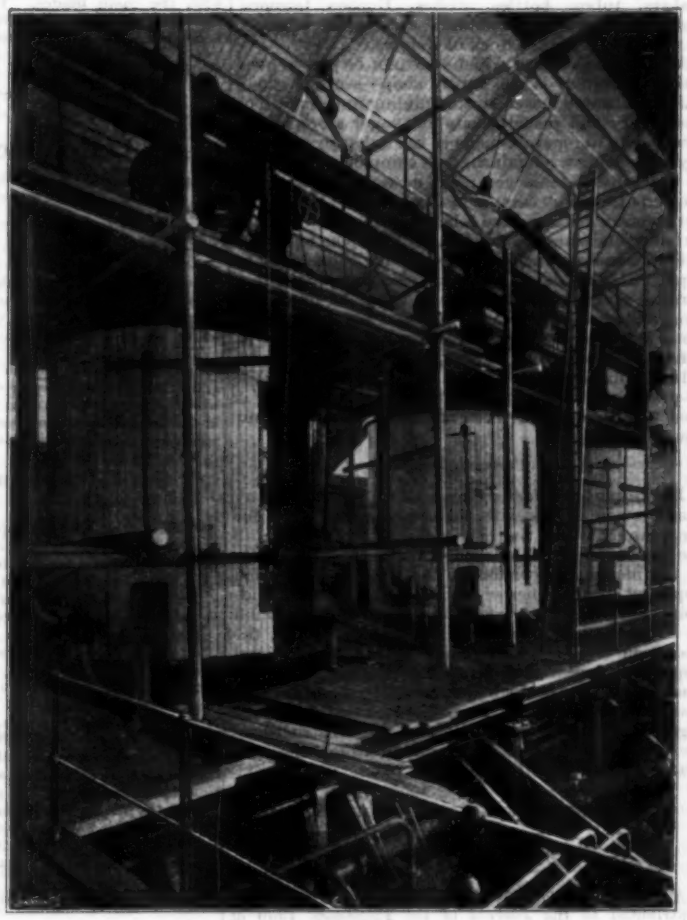


FIG. 32—THE VACUUM PANS

trifugal action, leaving the sugar crystals clinging in a white mass evenly round the inside of the basket of the centrifugal. While the machines are still in motion a small quantity of pure filtered water is sprayed against these walls of sugar, and then covers are put on and superheated steam is admitted to the basket, with the result that the sugar crystals are dried. The sugar thus formed is shovelled out of the basket on to a jigging conveyor, which takes it into the sugar store next door, where it is elevated by a conveyor on to a platform which is furnished with an automatic weighing machine from which it drops through spouts into bags for dispatch or storage. A view of the weigher and sacker is given in Fig. 23.

The liquid draining from the centrifugals is mingled with scourings from any of the *malaxeurs* which may be empty, the mixture being taken again to the vacuum pans and boiled. The discharge from the pans is in this case to another set of *malaxeurs*, the *massecuite* from which is dealt with in one or other of the two "second jet" centrifugals. The resulting sugar crystals, which are not so white as those produced by the "first jet" centrifugals, are melted in one or other of the two melting boilers which are alongside the "second jet" centrifugals, the syrup thus formed being mixed with a quantity of the syrup coming from the quintuple-effect evaporators and being taken through exactly the same processes as detailed above, commencing with sulphiting and ending with the "first jet" centrifugals, fine white sugar crystals being produced. The discharge from the "second jet" centrifugals is what is known as molasses, which is particularly valuable for cattle food, either mingled with dry beet pulp, as explained above, or with other fodder.

During all the processes of beet sugar manufacture the endeavour is made to lose as little heat as possible. All steam which, having performed one duty, possesses sufficient heat to be usefully employed in another direction is so used until the last available heat units have been removed from it. The exhaust from the engines is all used in the heaters, and beyond the barometric plant, which deals with the exhausts from the evaporators and the vacuum pans, there is no condenser.

THE LABORATORY AND REPAIR SHOP.

A description of this interesting factory would be incomplete if mention were not made of its laboratory, which is fitted up for carrying out tests, not only of the juices, syrups, &c., and of the finished product, but of the beet, limestone, and other raw materials employed in the works. It is contained in a large, airy, well-ventilated room, furnished with all the necessary sinks, fume closets, &c. Among its equipment we noticed several chemical balances, gas and electric furnaces and muffles, electric stoves, apparatus for analysing carbon dioxide, apparatus for limestone analysis, *cosette* presses, thermometers, saccharimeters, aerometers, densimeters, and a first-aid chest, as well as a full supply of utensils, flasks, beakers, tubes, bottles, dishes, Bunsen burners, burettes, pipettes, crucibles, aspirators, funnels, &c. &c., and a goodly stock of chemicals.

Another department which must not be passed over without mention is the repair shop—see Fig. 26—which is situated in a separate building to the south of the factory and just opposite the sugar store. It is there ready to repair damage in the unhappy event of anything going wrong during a "campaign," and also so that any necessary repairs or renewals may be effected after the "campaigns" are over. It has two lathes, one a 15in. and the other an 8½in., both sliding, surfacing and screw-cutting; a 10in. shaping machine; a double-ended punch and shears with 18in. by 20in. gaps; a 16in. sensitive drilling machine; a pipe-bending machine; a screwing and tapping machine; rivet and smiths' forges; a pressure blower; grindstone and tool grinder, &c., and a full equipment of benches, vices, countershafts, &c. It is driven by a hot bulb oil engine, which also drives a 30 kVA 50-period alternating-current generator, which is used to provide light when the main factory is shut down.

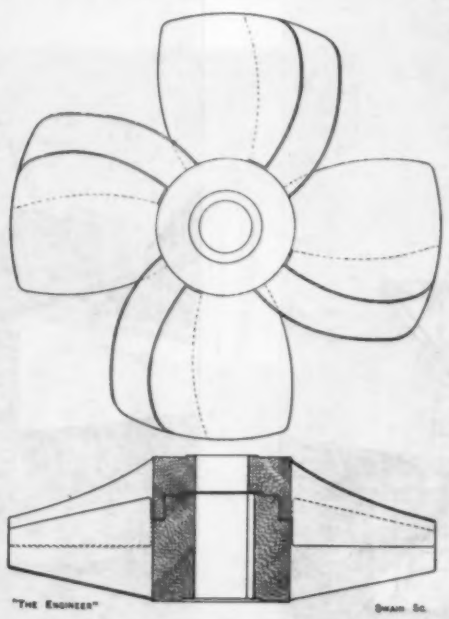
CONCLUSION.

Looking at the factory as a whole, we would say that we were struck with the completeness of all the arrangements and the thoroughness with which all the details had been worked out. There were things in the machinery portion of the undertaking which appeared strange when viewed from the British standpoint, but they simply reproduce what has been found to be successful in France. On the other hand, the operation of the very numerous machines and apparatus appeared to be excellent, and there is no question as to the high quality of the sugar which was being produced. A word, too, must be added regarding the excellent design of the constructional work and the first-class manner in which the contractors have carried it out.

A New Turbine Runner.

A PAPER on "The Hydraulic Turbine in Evolution," contributed to the *Journal* of the Engineers' Club of Philadelphia, by H. B. Taylor and L. F. Moody, is concerned chiefly with the improvements which have been made in high-speed turbines of the type which was illustrated and described in THE ENGINEER of May 13th, 1921. The authors show the great extent to which the size of turbine runners has been reduced within recent times, and point out the important effect which eddies have on the running of high-speed machines. In this connection, reference is made to the peculiar type of runner, illustrated herewith and designed by Mr. Moody, in the following terms:—

"As it is believed that there is a tendency in a narrow-bladed runner for an eddy to form behind each blade at part gate and sometimes even at normal gate, one of the writers has proposed the use of secondary blades close to the main blades, but slightly in advance



COMPOUND TURBINE RUNNER

of them, for the purpose of directing the flow more efficiently along the back of the main blade, and by this means eliminating instability and vibration, and improving the part-gate efficiency, &c. The illustration shows a four-bladed axial-flow runner equipped with such secondary blades, the two blades being in contact in the position shown. The secondary blade is of diagonal-flow form. It was found by tests that the addition of the secondary blades, or 'intervanes,' reduced the specific speed, but increased the efficiency by 8 per cent., and that it prevented unstable flow and vibration and improved the part-gate efficiency. It was found that the best angular position of these blades was about 10 deg. in advance of their position of contact with the main blades. The field of usefulness of the idea has yet to be determined; it is merely presented here as a suggestion of interest."

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

CHINESE PURCHASES OF FOREIGN MATERIALS.

SIR,—As the accredited buying agents in London of the Peking-Mukden Railway, our attention has been drawn to a paragraph which appeared in your issue of the 14th ultimo under the heading of "Chinese Engineering Notes."

The account given in this paragraph of the buying arrangements of the Peking-Mukden Railway is not altogether correct, and I shall feel obliged if you will give publicity to the letter which we have received from Mr. D. Poyntz Ricketts, engineer-in-chief and general manager of the Peking-Mukden Railway, which we enclose herewith, as it defines the position accurately.

J. WHITTALL AND CO., LTD.,
E. S. H. CORBETT, Managing Director.

London, August 18th.

DEAR SIRS,—A paragraph in THE ENGINEER of July 14th has been brought to my notice regarding the method of purchase by the Peking-Mukden Railway of foreign materials.

As this has, I understand, produced an erroneous impression amongst manufacturers in this country as to who arranges our purchases and contracts in London, I should be obliged if you will explain to the Editor of THE ENGINEER that no alteration in our regular practice has been made by appointing a supervisor of purchases. This individual is only called upon to assist our agents when specially instructed to do so by the engineer-in-chief and general manager of the Peking-Mukden Railway in China, and as that is only occasioned in certain special cases, it will hardly affect our general practice.

I would also point out that the statement that few British firms or rather their local agents in China are asked to tender in China is correct, as we get better service by dealing direct with the principals in England and other countries through our London office. We have placed contracts in China with British firms, who have forthwith ordered the material on the Continent, and not from British manufacturers, without efficient results.

Yours faithfully,
D. POYNTZ RICKETTS,
Engineer-in-Chief and Manager,
Peking-Mukden Railway.

An American Continuous Baking Oven.

AN illustration of the application of engineering skill in food production processes is the design and introduction of an automatic continuous bread-baking oven for a large American bakery. With the ordinary oven the loading and unloading require considerable time, and as the first loaves charged are the last to be removed, considerable skill on the part of the baker is required to prevent an undue proportion of apoilt or unsatisfactory bread.

In the development of the new oven, as described at a meeting of the Western Society of Engineers by Mr. W. A. Darrah, of the Continental Industrial Engineers' Company, the object was to produce superior results, to eliminate skilled labour, to ensure uniformity, and to reduce the cost of the baking operation. After a study of oven operation and the principles of bread-making a distinctive cycle of baking was developed, as follows, for a continuous oven equipped with automatic control of temperature:—

First, heating the under side of the bread in the pans to a temperature of about 600 deg. Fah. for about 5 min., while at the same time the upper side of the loaf was maintained at only about 300 deg. This period occupies about 10 min.

Secondly, submitting the loaf to a "soaking" heat in which the temperature of the under side and upper side of the loaf were practically equal, and averaged about 500 deg. This period lasted for about 10 min.

Thirdly, another "soaking" period of the same length, during which the temperature of the upper side of the loaf was gradually increased while that of the under side was decreased.

Fourthly, a final flashing heat of about 660 deg. on the upper portion as the loaves pass out of the oven.

The first period of heating from the bottom is to cause the dough to rise by the expanding of the bubbles of carbon dioxide and air, thus producing a large and light loaf. On the other hand, although it is necessary to form a slight surface skin to prevent undue escape of the gases, it is undesirable to form any noticeable amount of crust at this period, since it would be cracked by the rising of the bread, and thus give it an unsightly appearance.

The second period is to heat the bread uniformly throughout its mass to the baking temperature. This converts part of the starch into inert sugar and other digestible substances, and also checks fermentation, sterilises the bread, fixes the gluten and develops the flavour. Although the oven temperature during this period is about 530 deg., that of the interior of the loaf does not exceed about 215 deg. During the entire baking thus far the bread is of a pale yellow colour on the outside, although it is thoroughly baked. The final operation, therefore, is the flashing or browning heat, which gives the desired colour and general appearance. When a thin, soft crust is desired, a short application of 660 deg. temperature is used, but a longer application of lower heat can be used to produce a thicker and harder crust of the same general appearance. The flashing temperature of the automatic oven can be adjusted to the desired degree and length of application.

This automatic continuous oven consists of a series of horizontal flues, communicating with vertical flues at the central portion of the oven. The mixture of air and gases enters at each end and passes toward the middle, from which it returns over the top of the oven to a distance of about 7ft. 6in. from each end, where it is taken by a connection to the chimney. On the upper portion of each end of the oven is an auxiliary heating space to control the top heats on the entering and leaving loaf, this space being supplied with hot gases from the outer auxiliary burners at each end.

A layer of heat-conducting material of graduated thickness is provided along the longitudinal flues which run the entire length of the oven. To secure a relatively high degree of heat on the bottom of the loaves entering the oven, this covering is omitted entirely at the entering end. But at the leaving end the covering is thick, so that the bottom heat on the loaves will be low.

A conveyor, 5ft. wide, carries the pans of bread through the oven at a controlled and uniform speed, which for ordinary bread-making is about 1ft. per minute. For cakes, pastry, &c., the speed is varied as required. No driving mechanism is within the oven, and as the interior parts do not exceed a temperature of 600 or 700 deg., there is no great deterioration from this cause. With graphite lubrication good mechanical operation is secured. The vibration of the conveyor is very slight and does not affect the most delicate cakes.

Town's gas is used for heating the oven, the fuel value ranging from 500 to 550 B.Th.U. per cubic foot. This gas is mixed with about half the total amount of air required for combustion, and the mixture is compressed to a pressure of about 15 oz. per square inch. The additional air necessary is added at the Bunsen burners. Automatic temperature control is maintained by thermostatic regulators placed within the upper and lower portions of each end of the oven. These devices act by closing by-pass valves, which so reduce the gas supply that only sufficient is burned to compensate for radiation and other losses. The flames are never extinguished, the normal heat requirements of radiation and stack or chimney loses being maintained constantly.

Experience with the operation of this oven has shown that the bread produced is remarkably uniform in size, shape, flavour, colour, and general appearance; the number of defective loaves is reduced to a very small figure, and there is a material reduction in the loss of moisture from the bread during the baking period. With the ordinary oven there is a loss of 12 to 15 per cent., while with the automatic continuous oven it is only 9 to 10 per cent. The fuel consumption averages three-tenths to six-tenths of a cubic foot of 500 B.Th.U. gas per one pound loaf of bread produced.

A Seven-Day Journal.

Aerial Traffic Control.

THE growth of traffic on the continental air services has now reached a point at which the Aerial Traffic Controller, an Air Ministry official, can claim to justify his existence. To aid him in his work the control tower at Croydon has recently been fitted up with new wireless telephonic apparatus constituting a kind of exchange whereby it is possible to get into communication with the pilot of any machine in actual flight. The Controller by this means issues orders as to where and when an incoming machine is to alight so as to avoid encountering an outgoing machine. The exchange, in addition, permits the pilot of a machine to get connection with any office in the aerodrome, and allows the Traffic Controller to broadcast weather reports to all machines in flight. It is stated that the new arrangements have been perfected to a high degree, so much so that recently the Controller was enabled to establish connection with an air express flying over Holland.

Underpinning in Downing-street.

THE method adopted for underpinning the walls of Nos. 10 and 11, Downing-street, work on which is now progressing rapidly, is somewhat unusual. The original footings were not considered good enough to support the new foundations, and, as a consequence, it was decided to discard them for the purpose of carrying weight. Completely new bases of steel work are being formed. On each side of the walls excavations are being made for steel girders laid parallel with the walls and about a foot away from the faces. These girders will be bedded in concrete, and will be used to support short cross girders passing through holes to be pierced in the walls. The new foundations will then be about 6ft. in width, and will be exceptionally strong.

Sheffield Steel Products.

IN a circular issued at the end of last week to the shareholders of Sheffield Steel Products, Limited, the directors review the present position of the company, and refute certain rumours concerning it which have once again been in circulation. The position, it is admitted, is difficult, but it is steadily improving, particularly in the cutlery and plate sections. The company's activities have, however, been severely restricted by a lack of sufficient working capital. In April £500,000 of second debenture stock was offered, but only £175,000 worth was applied for by the public. This shortage has prevented the company's steel plant from being put into operation, and has prohibited the acceptance of orders involving the granting of long credit. The directors have decided to have a complete audit of the accounts made up to July 31st before making fresh efforts to secure the balance of the necessary capital. Sir George Buchanan and Brigadier-General H. A. Young, late Director of Ordnance Factories in India, have recently inspected the company's factories and business, and have reported to the board that they can see no reason to be pessimistic about the future. The situation, they believe, will remain difficult until there is a real revival of trade, but if concerted efforts are made by all concerned to secure economy and efficiency in organisation and manufacturing methods, there is no reason to doubt eventual success.

New N.E.R. Electric Locomotive.

THE first of the North-Eastern Railway's new 4–6–4 type electric locomotives, a drawing of which was given in our issue of December 30th last, has now been completed. This engine was designed by the railway company, the electrical equipment being supplied by the Metropolitan-Vickers Company. It is capable of developing 1800 horse-power on a one-hour rating, or 1260 horse-power continuously, and is designed to draw a load of 450 tons at an average speed of 65 miles an hour. Its running gear is constructed for a maximum speed of 90 miles an hour. We understand that the new engine will first be tried on the 44-mile run between York and Darlington, and later on for hauling the Flying Scotsman between York and Newcastle.

Glasgow to Buy American Rails.

BY a narrow majority, after a stiff and heated discussion, the Corporation of Glasgow has decided to place an order for tramway rails with the United States Steel Products Company at a contract price of £15,335 as compared with £18,262, the lowest British tender. Against the acceptance of the American offer it was urged that no authentic guarantee had been received from the Steel Products Company that it would pay trade union rates to its workpeople engaged on the contract and otherwise observe trade union conditions, and that, in fact, it was a subsidiary of the American Steel Corporation, a trust which, it was alleged, refused to accept the eight-hour day and prevented its workpeople from organising and giving free expression to their views. A letter from the Steel Products Company's agent was submitted and accepted by the majority as satisfactorily ensuring that trade union rates and conditions would not be violated. In this letter it was stated, as evidence of the rates paid, that it was becoming a problem how to provide space in which to park the employees' motor cars. In favour of accepting the American offer it was urged that the Corporation was not justified in spending £3000 of the ratepayers' money for the relief of unemployment in Sheffield. On a division, 33 votes in favour of and 31 against accepting the American offer were recorded. The Corporation's decision has already been severely criticised in iron and steel circles.

A Motor Sailing Vessel.

AN interesting vessel is now berthed at Birkenhead, the four-masted barque, Magdalene Vinnen, built by Krupps at Kiel, and owned in Bremen. The vessel is of the auxiliary type, and is equipped with a four-cylinder 500 horse-power Diesel engine. The propeller has reversible blades, and can be so set as to offer very little resistance to the ship's motion when the sails alone are in use. The cargo-carrying capacity of the vessel is about 5150 tons, and the speed when under power six to seven knots. On her maiden voyage the vessel occupied thirty days between Penarth and Buenos Aires, and forty days on the return trip to Falmouth. The total of seventy days for the round voyage is not greatly in excess of the time occupied by an ordinary tramp vessel for the same distance, while the cost of running is stated to be greatly in favour of the motor sailing ship.

The Napier "Cub" Aero-engine.

RUMOURS recently in circulation regarding the possession by this country of a new and mighty aero-engine capable of permitting bombing at a radius of 3000 miles—New York and back non-stop!—turn out to be considerably less sensational than they seemed to be before confirmation of them was sought. The engine in question, it now appears, is the Napier sixteen-cylinder 1000 horse-power "Cub," of which photographs and a certain small amount of technical information have been available for at least the last eighteen months. Details of the design are still closely guarded, but it is stated that the engine speed is 1800 revolutions per minute geared down to 750 at the propeller, and that the weight is about 3 lb. per horse-power. Six of the engines have been ordered by the Air Ministry, and are to be tested in the first instance on machines of the Avro "Aldershot" type. To some people mere size, particularly in aeronautical matters, is everything. Actually it is by no means agreed that an aeroplane with a single 1000 horse-power engine must necessarily be superior in range or any other respect to one fitted with two 500 horse-power engines.

The Croydon Air Port.

THE announcement that the Instone Air Line has ceased to carry goods on its cross-Channel aeroplanes solely because of the expense incurred in collecting and delivering the freight before or after the voyage lends point to the representations now being made that a site nearer to London than Croydon should be selected to which our principal air port should be transferred. The Civil Aviation Advisory Board is considering the matter, and it is probable that a recommendation will shortly be made to change the site to one at Wormwood Scrubs, Hendon, Cricklewood or somewhere else less remote and more easily reached than Croydon. While pilots are fairly well agreed that Croydon is suitable from the flying point of view, it is undoubtedly true that its distance from London has formed one of the handicaps to the development of civil aviation, for it has frequently happened that as much time has been spent in getting to and from the terminal aerodromes as was occupied by the actual flying portion of the journey. Meanwhile little or nothing has been heard of anything further being done to develop a flying boat service from the heart of London with the Thames as the point of arrival and departure.

Proposed Motor Vehicles Bill.

RECENT accidents to public motor vehicles in this country have directed much attention to the position of the Ministry of Transport as regards the regulation and control of road traffic. That position, it would appear, is in some respects ill-defined and unsatisfactory. The Ministry, for instance, has no power to inquire into road accidents and their causes as it has in the case of railway accidents, but has to depend upon the voluntary co-operation of the police and others for any investigations which it may desire to make. Again, it cannot prohibit or restrict the use of vehicles of any specified class on any specified highway except upon the application of a County Council or County Borough Council. In these and other respects it is proposed to extend the Ministry's control over road traffic in a Bill now being prepared for presentation to Parliament. It is probable that in this Bill an effort will be made to restrict the size of motor coaches on the lines proposed by Sir Henry Maybury's Departmental Committee. That Committee, it may be recalled, suggested that no motor coach should exceed 27ft. 6in. in length or 7ft. 6in. in breadth, and should not have an overhang behind the rear axle in excess of seven-twenty-fourths of the maximum length.

An American Motorship's Performance.

PARTICULARS have been published by the United American Lines of the performance of the motor ship Californian on her maiden voyage from New York to San Pedro, on the Pacific Coast, a total distance of 4866 miles. The average speed was 12.2 knots and the average revolutions 112 per minute. The voyage lasted 16 days 23 hours, and during it the mean draught of the vessel was 21ft. 11in. On an average indicated horse-power of 4405 the fuel consumption amounted to 14.3 tons per twenty-four hours, or 0.304 lb. per indicated horse-power hour. The fuel oil had a specific gravity of 23.5 Beaumé. The Californian is a twin-screw vessel of 11,000 tons deadweight, and was built by the Merchant Shipbuilding Corporation, of Chester, and engined by Cramps, of Philadelphia, with two Diesel engines of the Cramp-Burmeister and Wain six-cylinder four-cycle type. A sister ship, the Missourian, has recently been delivered by the same builders.

Industrial Negotiations and Agreements.

A PAMPHLET entitled "Industrial Negotiations and Agreements," priced at two shillings, has been issued by the Trades Union Congress and Labour Party with the object of presenting in a convenient form systematised information regarding various important agreements established either by law or mutual consent between employers and industrial workers. Information is given regarding trade boards, boards of conciliation and arbitration, sliding scales, joint industrial councils, cost of living scales, and other matters. The work should prove of as much value to employers of labour as to those for whom it is presumably primarily intended.

Shipbuilding Activity.

THAT the shipbuilding industry of the country is not quite at a standstill is evidenced by the fact that within twenty-four hours at the end of last week three vessels, all for the same owners, were launched from three different yards. On Thursday the British Merchant was launched by Messrs. Beardmore from their Dalmuir yard on the Clyde. On Friday, Messrs. Swan, Hunter launched the British Scout, and Messrs. Palmer the British Premier. All three vessels are oil tankers constructed to the order of British Tankers, Limited. The Merchant and Premier are driven by double-reduction geared turbines, while the Scout is equipped with triple-expansion engines. It is also a sign of some improvement in the shipbuilding industry that during the past week or so orders for five new vessels have been announced by Clyde shipbuilders. John Brown and Co. are to build at Clydebank two cable-laying steamers for a British cable company, a British India liner is to be built by Barclay, Curle at Whiteinch, and two steamers for British-Asiatic ownership are to be built by Messrs. Connell at Scotstoun.

Sir Eric Geddes.

IT has been stated that Sir Eric Geddes had been offered and had accepted the presidency of the Federation of British Industries in succession to Colonel O. C. Armstrong. This statement is neither confirmed nor denied by the Federation officials. The new President will be elected at the annual general meeting next month. Since his resignation from the Ministry of Transport, it may be recalled, Sir Eric has joined the board of the Dunlop Rubber Company.

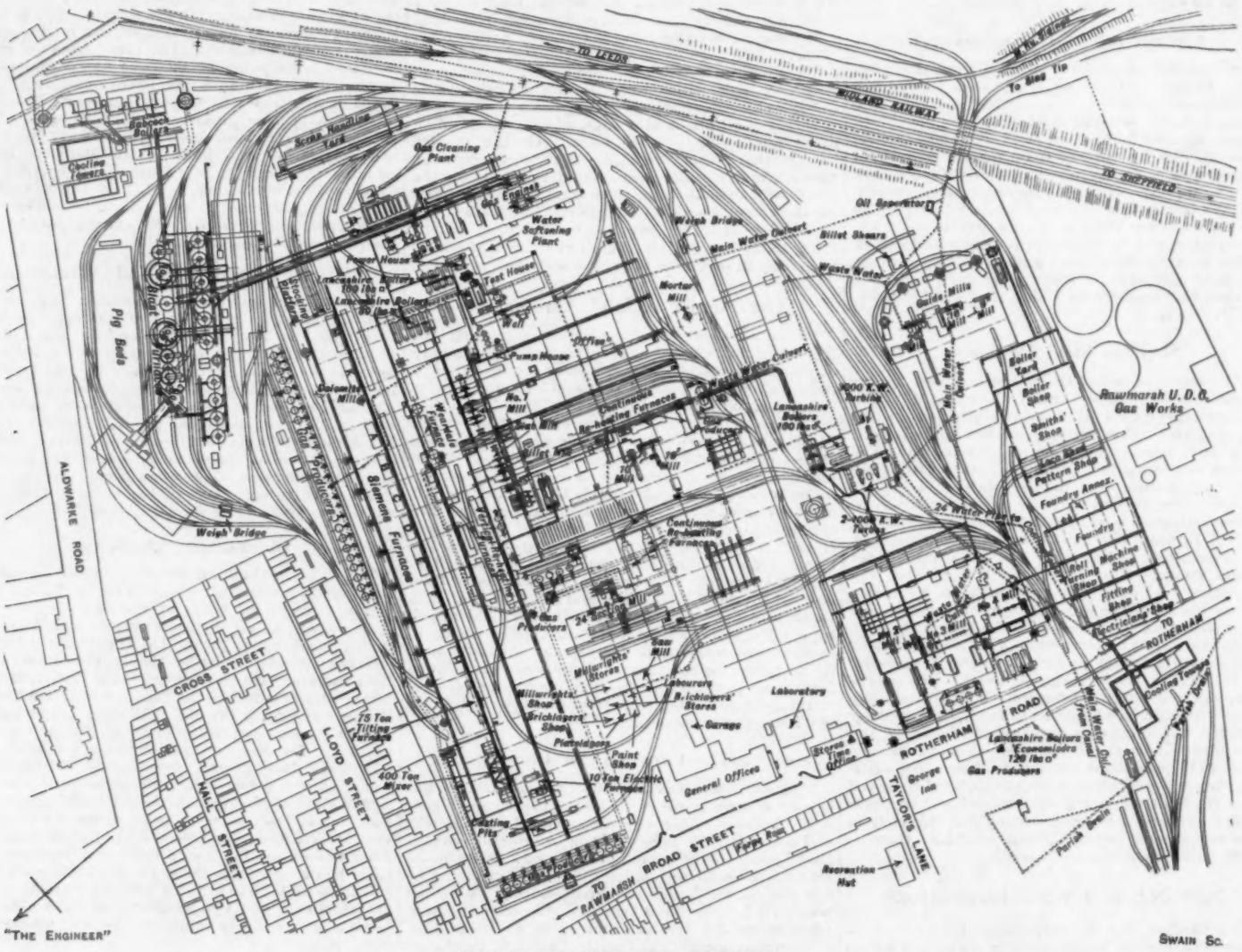
Warships to be Scrapped.

THE Admiralty has doubtlessly had a hard task in deciding which warships were to be scrapped in accordance with the Washington agreement. Its announcement that its choice has fallen on the battle-cruisers Lion and Princess Royal and the battleships Orion, Monarch, Conqueror and Erin will be received with something like regret for these six vessels bore a prominent part in the war, and embody a volume of sentiment which cannot readily be replaced. The passing of the two battle-cruisers especially will be viewed with regret, for they were leading participants in three of the chief naval actions of the war, the Battle of the Bight in August, 1914, the Dogger Bank action in January, 1915, and Jutland. All the vessels carry 13.5in. guns.

The Park Gate Ironworks.

THE members of the Iron and Steel Institute have been invited by Mr. C. P. Markham, chairman of the Staveley Coal and Iron Company, Limited, near Chesterfield, and of the Park Gate Iron and Steel Company, Limited, near Rotherham, to visit the works of those companies at the close of the autumn meeting, which is being held this year in York. A description of these works will be of interest, therefore, to readers of THE ENGINEER, notwithstanding that a very full account of the blast-furnace plant at Park Gate appeared in these columns in 1919.* In the present article the Park Gate Works will be dealt with as a whole, while a subsequent article will be devoted to a description of the works of the Staveley Coal and Iron Company, Limited.

The Park Gate Works were founded in 1823, and became the property of the Park Gate Company in 1864. At that time they consisted of a blast-furnace, puddling furnaces and rolling mills, and the output consisted chiefly of iron rails. The puddling furnaces were dismantled in 1908. It is interesting to note that the plates for the Great Eastern were rolled at the works, and also that the plate mill was the first reversing rolling mill to be installed in the country. At one period, likewise, the company was the only one engaged in the manufacture of armour plate, while it was at Park Gate that the first Bessemer ingots, made in Sheffield, were rolled.



PLAN OF THE PARK GATE IRONWORKS

BLAST-FURNACE PLANT.

The blast-furnace plant at Park Gate consists of three furnaces—No. 1, rated at 900 tons per week and equipped with three Cowper stoves and an equaliser; No. 2, rated at 900 tons per week and similarly equipped; and No. 3, rated at 1000 tons per week, but more often averaging 1100 tons and having to date a record output of 1148 tons, the equipment of which comprises a battery of four Cowper stoves, 75ft. high and 21ft. in diameter. Furnaces Nos. 1 and 2 were built sixteen years ago, and have been in continuous operation ever since, with only one relining. No. 3 is a new furnace, built during the war and blown in during July, 1918. For the full dimensions and for details and drawings of the furnace top, reference may be made to the issue of THE ENGINEER for July 6th, 1919, of which mention has already been made, and to the schedules published in the paper on "Blast-furnace Practice," contributed by Mr. Fred Clements at the May Meeting of the Iron and Steel Institute in 1920, and published in the *Journal* of that Institute. This paper gave copious data, not only of the Park Gate furnace, but of a large number of other British blast-furnaces, and has already attained the standard of a classic in relation to the subject with which it dealt. It will suffice, therefore, in the present instance briefly to summarise the principal dimensions and to give a short description of the method of charging and distribution.

The principal dimensions of furnaces Nos. 1 and 2 are:—Hearth diameter, 11ft.; bosh diameter, 18ft. 6in.; stock line diameter, 13ft.; and height 70ft. The dimensions of No. 3 furnace are as follows:—Height, 70ft.; hearth diameter, 11ft.; bosh diameter, 20ft.; stock line diameter, 13ft. The blast pressure employed is 6½ lb. per square inch, and the temperature averages 1020 deg. Fah. There are eight 5½in. tuyeres and two 3½in. tuyeres. The charge consists of a mixture of raw Lincolnshire, Leicestershire and Northamptonshire ores, averaging 32 per cent. of iron, and containing considerable moisture, which during the winter months may amount to as much as 25 per cent. The ores possess, however, the advantage of being self-fluxing. As delivered they contain approximately 25 per cent. of lumps, 35 per cent. of medium, and 40 per cent. of fines. South Yorkshire coke, derived mainly from the Staveley coke ovens, is used in the proportion of 28 cwt. per ton of pig iron produced—equivalent to 23 cwt. of carbon.

With a burthen of this nature, it will readily be understood that special care is necessary to secure satisfactory distribution. Skip charging has been adopted, the skips being raised on a double track incline, and the charge dumped on to a revolving stock distributor. The furnace top is equipped with a double bell. The capacity of the skips is 30 cwt. of ore, or 12½ cwt. of coke. Every stage of hoisting, tipping, rotating the hopper and raising and lowering the bell is faithfully recorded by an indicator in the control house, the operator having before him a model of the furnace top and being able to control with ease and accuracy the whole sequence of operations and stock distribution. The system, both of control and of the furnace top itself, has been devised and patented by Mr. Clements.

The blast is furnished by two gas-driven blowing engines, designed by the Snow Pump Company, Buffalo, N.Y., each capable of delivering 25,000 cubic feet of air per minute at 8 lb. pressure per square inch, and three double-acting gas-driven engines of the Körting type. A double-acting steam-driven blowing engine is installed as a stand-by.

The gases from the furnaces issue at a temperature varying from 300 deg. to 400 deg., and enter a dust catcher, 25ft. internal diameter and 40ft. high, where they impinge on a large steel cone, thereby undergoing a sharp change of direction and a considerable fall in velocity. For use under the boilers they undergo no further cleaning than is involved by their traversing the above chamber and the ordinary baffling of the gas main system. For use in the gas engines they are first thoroughly washed in water spray saturator towers, and finally passed through a Theisen cleaner, where their dust content is reduced to 0.02 gramme per cubic metre. Of the blast-furnace gases evolved, 35 per cent. is used in the stoves and 50 per cent. is burned under boilers. The boiler plant consists of a battery of nine Babcock-Wilcox boilers, generating steam at 160 lb. per square inch. A further battery is in course of construction, provision being made for firing the new boilers, either with blast-furnace gas or, if for any reason the supply should fail, with powdered coal. Superheating is carried out to a moderate extent, and the steam raised is used for various purposes in and about the works. The exhaust from the mill engines is collected and used in mixed pressure turbines, which provide for the electrical power requirements of the works. The remaining 15 per cent. of blast-furnace gas—or, allowing for waste, 14 per cent.—is used in the gas engines. The pig iron is taken, in 25-ton capacity ladles, to the steel works, where it is tipped into the metal mixer. The slag is run into 8-ton Dewhurst tipping ladles.

OPEN-HEARTH PLANT.

Open-hearth steel has been made at Park Gate since 1888, the original plant having consisted of two 25-ton hand-charged basic open-hearth steel furnaces. Later, an acid-lined furnace was added, but the present plant consists solely of basic steel furnaces, and the skill displayed in its manufacture has gone far to eradicate the former prejudices in favour of acid steel, the manufacture of which was discontinued in 1917.

The present plant is very extensive and thoroughly up to date. It consists of a 75-ton tilting furnace—which was originally a 200-ton metal mixer, but has been ingeniously "converted"—three 60-ton fixed furnaces, and seven 50-ton fixed furnaces, the aggregate capacity of the plant being thus little short of

* THE ENGINEER, July 6th, 1919.

6000 tons per week. There is also a 10-ton Greaves Etchells electric furnace, taking hot metal from the open-hearth furnaces for further treatment.

The dimensions of a typical 60-ton furnace—a view of one of which is given in our Supplement—are given in minute detail, together with logs of the working of a charge, in a further paper by Mr. Fred Clements, on Siemens open-hearth practice, read at the May meeting of the Iron and Steel Institute this year. The main features are as follows :—

Distance between port blocks	30ft.
Width between walls	12ft.
Gas port	16in. by 16in.
Gas port incline	1 in 3ft. 6in.
Gas chequers	12ft. by 8ft. 3in. by 12ft. 4½in.
Gas chequers, volume	1225 cubic feet
Air port incline	1 in 3ft. 6in.
Air chequers	12ft. by 11ft. 6in. by 13ft. 1½in.
Air chequers, volume	1810 cubic feet

These dimensions refer to furnace "M."

The gas valves are of the water-sealed reverse modified Wailes type, the air valves being of the dry type, with double-seated mushroom valves. The valves are all easily operated by hand through reduction gear, ball bearings being used throughout.

The charges worked average 50 per cent. scrap, charged by Wellman ground type charging machines, and 50 per cent. mixer metal, this being added after the scrap has been partly melted. The mixer practice is of considerable interest. The mixer—two views of which are given in our Supplement, and which is of 400 tons capacity—is gas fired by its own battery of modified Dawson producers, with their accessory coal-handling and storage plant, is of the active type, and, in addition to the ordinary desiliconisation and desulphurisation which occurs, a considerable proportion of manganese present in the pig iron slags out, leaving approximately 0.6 per cent. in the molten metal. The slag produced averages 1 cwt. per ton of pig iron passed through the mixer, and as this slag contains from 20 to 24 per cent. of MnO, it is used in lieu of manganese ore in the blast-furnaces, where it is again reduced in the pig, thus forming a cycle of operations which obviates the use of manganese ore in the burden, while affording a more steady and constant source of the manganese required in the pig iron, and hence in the mixer metal and eventually in the open-hearth furnace bath. It will be recalled that during the war the German steel makers were driven for lack of manganese ore to adopt a similar cycle of operations, and that manganiferous slag, both from old ferro-manganese furnace slag tips and from mixers, was freely used to remedy the deficiency. The following analysis of the mixer slag in question may be regarded as typical :—

Analysis of Mixer Slag.

Silica	32.0 to 34.0
Alumina	7.0 to 9.0
Lime	34.0 to 38.0
Magnesia	3.0 to 6.0
Sulphur	0.03 to 0.07
Manganese oxide	20.0 to 24.0
Iron	2.5

Limestone and Gellivara ore are added to the molten metal in the mixer to form this slag.

Producer gas for the open-hearth furnaces is supplied by a battery of twenty-six Dawson type steam-blown producers, 7ft. internal diameter, and capable of gasifying 8 cwt. of coal each per hour. To some of these producers steam-blown "P.G." poking holes have been provided. These holes, by the ingenious employment of a steam screen, enable poking and inspection to be carried out without the gases escaping.

An electrically propelled ladle carriage has been installed to serve the 75-ton tilting furnace, and the intention is to equip the whole of the open-hearth furnaces with similar carriages. Stripping is effected by three 25-ton high-speed overhead cranes driven electrically. A Wellman electric ingot stripper has been added to deal with stickers.

The ingots are machine-charged to the mill reheating furnaces, which are gas fired and supplied with air regenerators.

ROLLING MILL PLANT.

The rolling mill plant comprises a large 39in. plate mill, a 38in. billet mill, a 36in. slab mill, all two high ; a three-high plate mill, rolling plates up to 35ft. long by 5ft. 8in. wide—a view of which is given in our Supplement ; a two-high 24in. finishing mill ; a two-high 24in. sheet mill ; a two-high 24in. section mill ; and 18in. and 10in. two-high section mills. The particulars of these mills are described below :—

	Slab Mill.	*Billet Mill.*
Size of mill	36in. diameter	38in. diameter
Engine	Two-cylinder, 50in. by 60in., reversing	Three-cylinder, 40in. by 48in., reversing
Size of product	36in. by 10in.	10in. by 10in. to 2in. by 2in.
Output per week, finished make	3000 tons	1400 tons

No. 1 Mill.

Size of mill—	
Large rolls	39in. by 12ft.
Hard rolls	30½in. by 8ft.
Engine	Two-cylinder, 50in. by 60in., reversing
Thickness of plates rolled	¼in. to 2½in.
Maximum weight	6 tons
Maximum length and width	60ft. and 11ft. 6in.
Output per week, finished make	1000 tons

No. 2 Mill.

Size of mill—	
Top roll	28in. diameter by 6ft. 6in.
Middle roll	18in. diameter by 6ft. 6in.
Bottom roll	28in. diameter by 6ft. 6in.
Engine	Single-cylinder, 34in. by 48in., continuous, 60 r.p.m.
Fly-wheel	38 tons
Thickness of plates rolled	$^{3}/_{16}$in. to ½in.
Maximum length and width	30ft. and 5ft. 8in.
Output per week, finished make	700 tons

No. 3 Mill.

Size of mill—	
Finishing rolls	24in. by 5ft. 6in.
Chequer rolls	24in. by 4ft. 6in.
Engine	Single-cylinder, 28in. by 42in., continuous, 60 r.p.m.
Fly-wheel	38 tons
Thickness of plates rolled—	
Plain	¼in. to ½in.
Chequers	¼in. to ½in.
Maximum length and width—	
Plain	20ft. and 5ft.
Chequers	24ft. and 4ft.
Output per week, finished make	200 tons

No. 4 Mill.

Size of mill	24in. by 5ft.
Engine	Single-cylinder, 24in. by 48in.
Fly-wheel	38 tons
Thickness of sheets rolled	16 G. to $^{3}/_{16}$in.
Maximum length and width	12ft. and 4ft. 6in.
Output per week, finished make	150 tons

24in. Section Mill.

Size of mill	24in.
Sections rolled	All British standard joists and channels from 10in. by 5in., 10in. by 3½in. downwards ; 9in. to 4in. rounds ; 6in. by 6in. angles, &c.
Engine	Three-cylinder, 36in. by 48in., reversing
Output per week, finished make	1200 tons

18in. Section Mill.

Size of mill	18in.
Sections rolled	From 4in. to 2in. rounds, 3½in. by 3½in. to 2in. by 2in. angles, 3½in. by 3½in. to 2in. by 2in. tees
Motor	250 horse-power A.C.
Revolutions of rolls	80 per minute
Output per shift, finished make	35 tons

10in. Section Mill.

Size of mill	10in.
Sections rolled	From 1½in. to ¼in. rounds, 1½in. to ¼in. hexagons
Motor	500 horse-power D.C.
Revolutions of rolls	150 to 250 per minute
Output per shift, finished make	25 tons

The 24in. section mill, which is typical of Park Gate rolling mill practice, may be described in greater detail.

It has been installed to provide larger sections than the company was able formerly to supply. All British standard sections are rolled; from 10 by 5 joists, 10 by 3½ channels, 6 by 6 and 8 by 4 angles, 9in. diameter rounds, &c., downwards. The mill will have an average output of about 1200 tons of finished sections, or rather more in favourable circumstances. A three-cylinder high-pressure steam engine, 36in. diameter by 48in. stroke, equipped with Joy's valve gear, provides the motive power. This engine was supplied by Markham and Co., Limited, Chesterfield. The exhaust is discharged into the low-pressure steam collecting main, and used in the mixed-pressure turbo-generator plant. The drive from the engine is direct to the bottom roll and through gear to the top roll, the length of the helical teeth being 4ft. 6½in. The gear is enclosed in an oil-tight and dust-proof casing, and the bearings are lubricated by an oil pump system.

The mill consists of three stands of rolls—roughing, forming and finishing—and all rolls are at fixed centres. The roughing rolls take a 10in. by 10in. billet, and it is chiefly out of this size that the various sections are produced in lengths up to 200ft. On one side of the roughing rolls an adjuster is installed, which passes the billet from one reducing hole to the next, whilst on the other side a manipulator is placed to turn over the billet for the next pass. Both the manipulator and adjuster are quick working by hydraulic power, and the cylinders and gear are arranged overhead, thus placing all working parts out of the way from scale, &c., and making these parts very accessible for repairs. On the one side a set of skids convey the bar from roll to roll. Each stand of rolls is equipped with its own fixed roller gear tables, the peripheral speed of the rollers being about 650ft. per minute. The drive for all roller gear from the motors, which are controlled by contactors, is through worm reduction gear, totally enclosed and running in oil baths. All mitre wheels driving rollers are enclosed in a gear case, and the tips of the teeth dip into an oil bath. All bearings for rollers are ring oil lubricated.

A 72in. hot saw, driven by a 200 horse-power alternating-current motor, cuts up the various sections into lengths required. The peripheral speed of the blade is 15,250ft. per minute. The feed is by means of hydraulic power. From the hot saw the material passes to the cooling bank, which is equipped with a double set of skids. Bars up to 60ft. long can be dealt with on this bank. The stock banks are equipped with cold saw and cold straightening machines, and also laying-out racks for inspection purposes.

The billets are conveyed to the mill furnaces by means of an overhead crane equipped with a special slinging attachment. They are placed upon the skids of the reheating furnaces by the crane, and are fed along the furnace hearth by a hydraulic pusher. The furnaces are of the continuous reheating type, fitted with a three-arch roof, in which the air only is pre-heated. They are wide enough to take a billet 10ft. long, and were designed and built by the Wellman-Smith-Owen Engineering Corporation, Limited. Four gas producers provide the gas necessary for the reheating of the billets in the furnace. All the electrical and hydraulic controls are housed on overhead platforms, from which the operator has an uninterrupted view. The quick changing of rolls is effected by having spare sets of housings, ready fitted up with rolls and guides, &c. These are picked up by an overhead crane and placed into position.

POWER HOUSE.

The electrical power plant consists of one 3000-kilowatt turbo-generator and two 1000-kilowatt turbo-generators. The former generates sufficient current for the whole works, and the two 1000-kilowatt machines are stand-bys. It was built by Metropolitan-Vickers, Limited, and consists of a Westinghouse Rateau mixed-pressure impulse turbine, direct coupled to a Westinghouse totally enclosed turbo type alternator. Alternating current is generated at 3000 volts, 50 periods, three-phase, .8 power factor at normal full load. A view of it is given on page 220.

The condensing plant consists of a Mirrlees-Leblanc multiple jet condenser, with rotary air and extraction pumps. Natural draught cooling towers are employed.

The alternating current is converted by transformers and rotary converters to direct current at 220 volts, this being the voltage used almost throughout the whole works plant. Part of the alternating current is used direct by some of the plant.

The Volumetric Dimensions of Boiler Furnaces.

IN our issues of August 5th and 12th of last year, in dealing with the use of pulverised fuel in power plants, a number of furnace arrangements were illustrated showing the application of this method of firing to boilers of various types. The most striking feature of those designs, whether the boilers were intended to use anthracite or bituminous coal in a pulverised condition, was the truly colossal size of the combustion chamber found necessary. Apart from questions of mechanical design, structural details or the use of proper materials, all of which have borne their full share in the troubles which have arisen in steam-raising plants, it has been in the provision of adequate proportions of combustion space in relation to the nature and quantity of the fuel to be burnt that most failures in boiler design have taken place. Furnace efficiency, or the ratio of the heat developed in the furnace to that of the thermal value of the dry fuel fired, is by far the most important element in boiler efficiency, or the ratio of heat converted into steam to that of the fuel fired, for the simple reason that the efficiency of transmission, or the ratio of the heat converted into steam to that developed by combustion, cannot exceed the latter amount in any case. So vast a proportion of the total heat of combustion efficiently utilised is transmitted by radiation from the furnace and absorbed in the first three or four rows of tubes in a water-tube boiler, or in the combustion space and first 5 or 10 per cent. of the tube lengths in a cylindrical or locomotive boiler, that apart from all questions of proper firing or adequate admission of air to the fuel, unless the actual furnace is proportioned in such a manner that full advantage can be taken of the combustion therein, loss of efficiency will inevitably result. To those who remember the early development of the water-tube boiler, particularly in its applications to marine work, and the subsequent attempts to burn oil fuel in combustion chambers designed for coal, this lack of adequate furnace volume will probably remain a bitter memory. By degrees, as experience with oil firing increased, the sizes of combustion chambers were greatly enlarged, and in the cases of the largest torpedo-boat destroyers' boilers, in which class are found the largest individual steam generators, single boilers capable of producing 120,000 lb. of steam per hour being now common, the absolute size of furnace volume has exceeded 1000 cubic feet. In this type of boiler, even 1.4 lb. and 1.5 lb. of oil per square foot of heating surface have been burnt per hour without difficulty, though this can only be effected efficiently provided that the quantity burnt per cubic foot of combustion space does not exceed about 10 lb. to 12 lb. It should preferably be less, and for mercantile work should not exceed about a third of this amount. Even the latter, however, gives what is, in comparison with coal-fired designs, a very large chamber in order that a proper mixture of air and oil particles may be obtained in the furnace prior to the dissipation of the hot gases amongst the tubes. The same basic principle, of course, applies to designs in which it is intended to utilise pulverised fuel, but the vastly larger combustion spaces required than even those necessary for oil will come as a considerable surprise to many engineers who have been contemplating the installation of such plants.

Some idea of the immensity of the actual furnaces

now deemed necessary in American practice for burning low-grade pulverised fuels may be gathered from the fact that in the case of the Stirling boilers supplied to the new Delaware power station of the Philadelphia Electric Company, which were illustrated in our issue of August 5th, 1921, which have a total heating, superheater and economiser surface of 20,820 square feet for a normal rating of about 55,000 lb. of steam per hour and an overload rating of about 100,000 lb., the furnace volume is about 7200 cubic feet—about seven times that the of the most powerful marine water-tube units afloat. This is when stepped mechanical grates for low-grade fuel are employed, and for use with pulverised fuel it is intended to increase even this volume very considerably.

Basic Principles.

The necessity for these vast chambers is brought about by a variety of causes, all of which, however, depend on those fundamental desiderata which should govern all boiler design and operation, and which, unfortunately, by the indifference with which they are so often regarded, fail to secure anything like the degree of efficiency of which many boilers are capable when they are observed. It should not be necessary, though the papers and discussions at the Institution of Mechanical Engineers in June, 1921, prove very conclusively that it is, to remind users of steam generating plant, that although it is nowadays so simple to purchase a standard boiler for a given steam pressure and guaranteed output in pounds of steam per hour, this production is obtained from the operation of certain natural laws of combustion and transmission of heat which apply equally to all kinds of fuel and all types of boiler, and that any transgression at any time of these laws, whether in the initial design or in the subsequent operation, simply means that each pound of steam costs so much more. Even apparently trivial matters of neglect augment the expense; they never reduce it or allow it to remain stationary. To obtain the maximum economical result, it is necessary that, as regards the fuel, there should be:—(*a*) The highest temperature obtainable in the furnace; (*b*) the lowest temperature obtainable at the point where the gases leave the boiler (or economiser or air heater, if fitted); (*c*) no more than the smallest possible quantity of air which will ensure complete combustion; and (*d*) as complete combustion as possible of the fuel gases in the furnace before they traverse the heating surface of the boiler. This much achieved, it then depends on the design of the boiler and on the laws governing the transmission of heat as to how much of the total heat generated in the furnace can be converted into steam. This process takes place in three different ways: by radiation, by convection, and by conduction, and the bibliography on the subject of their respective actions is very extensive. For at least fifty years, or even before Osborne Reynolds*, at Manchester in 1874 evolved the theory that the rate at which heat is given off by a hot gas to any colder surface over which it flows depends on the velocity of flow, controversy and discussion have followed one another incessantly, but the fact remains that it is still to a large extent uncertain in what proportions the transmission occurs. As long ago as 1909, Professor Dalby†, aided by Mr. Thieme, produced a list of over four hundred papers relating to the subject, and this was far from complete. But without elaborating the subdivision, quite sufficient experience has been accumulated to show that the vast majority is due to radiation. The whole subject of heat transmission is an extremely complicated one. By far the greater part of the whole temperature difference between the furnace gases and the water is absorbed in breaking down the resistance of the chilled gaseous film in contact with the metallic surface, and it is on the circulation of the media on either side of it far more than on the conductivity of the metal separating them that the rate at which heat will pass depends. The practical difficulties, and certainly the convenience when a boiler is in commercial use, prevent the collection of temperature data to a considerable extent; and even these, though of interest, are virtually useless for scientific purposes without careful simultaneous measurements of fuel consumed and water evaporated. The temperatures in a furnace are not exactly calculable, and they are often difficult to measure owing to their magnitude. Although this is the case in water-tube boilers, it is always possible to take readings between the tube rows a little above the furnace rows, and at intermediate points up to the exit rows, and then by deduction from calculations of the heat drop and total quantity of heat transmitted to the steam, to arrive at the amount put into the fire rows—*i.e.*, by radiation. This proportion is some measure of the relative importance to be attached to furnace surface and to ordinary heating surface, and for many years now, perhaps more as the result of practical experience than from the scientific analysis of carefully conducted trials, the general tendency in all types of boiler, whether locomotive, water-tube, or cylindrical marine type, has been to increase the former relatively to the latter surface.

The velocity of the gases through the boiler is also obviously a matter of very considerable importance: it is fluctuating everywhere owing to variations of temperature density. But once away from the furnace proper, when it commences to give up its heat to the surrounding surfaces, provided that it is sufficiently turbulent in its motion to destroy any tendency towards the adhesive formation of a cool film over the tubes, very wide variations of speed can be permitted without any material effect on the boiler efficiency. In the case of oil-fired boilers, many of which have been tested over a range of combustion running from 0.25 lb. to 1.25 lb. of oil per square foot of heating surface per hour‡, very small differences in boiler efficiency have been recorded over such wide variations of combustion as 0.3 lb. to 0.75 lb. per square foot; that is, in gas velocity a variation of 1 to 2.5. The reason lies in the fact that any reduction in furnace efficiency at the higher rate of combustion is balanced by the improved efficiency of heat transmission.

Air for Combustion.

The way in which the weight of air necessary for combustion is calculated from the ultimate analysis of the fuel, the details of the calculations for the specific heat of the furnace gases, or the analysis of performance deduced from data obtained from the chimney gas analysis are ordinary matters of routine in boiler design and testing when ordinary fuels are under consideration, and oil, perhaps, is the simplest of all to deal with. But many of the old troubles which arose when first attempting to burn it were simply due to the fact that the volume of air required for complete combustion and the space necessary for it to take place in had not been calculated, even if the principle of the necessity for perfect atomisation had then been grasped, and it is not too much to say that fifteen years ago there was far more trial and error than theory applied to the improvement of oil-firing installations. There have been a good many minor troubles arising out of the use of oil fuel in the last few months, when its temporary application to power stations was resorted to during the coal strike. Brickwork amply suitable for coal fires suffered severely under the oil flame, and inability to secure the perfect combustion obtainable with marine installations where adequate air supply is available were common. In some cases it seems that it was with something approaching relief that a return was made to coal fuel as speedily as possible, and this not merely on account of the excessive cost of oil. In Great Britain, unless oil can be supplied at not more than 55 to 60 per cent. above the cost of coal the steam generated will cost more when all details of expenditure are taken into account. But apart from cost, there is not the slightest reason why perfectly satisfactory operation with oil should not have been secured; in cases where difficulty arose it was due solely to the use of unsuitable methods of operation and application. It is a little lesson worth remembering for the future.

Pulverised Fuel.

The favourable reports which have been made by expert visitors to the United States regarding the use of low-grade pulverised fuel point to the possibility of a considerable development of this method of firing in Great Britain, and it requires little attention to the lessons of the past to foresee that furnace conditions are likely to prove a factor of considerable importance. There appears to be no practical difficulty in pulverising, drying and leading to the furnace almost any kind of low-grade fuel; the first matter for caution is that these vary very considerably in constitution. Pulverised fuel with an ash content up to nearly 50 per cent. has been burnt satisfactorily, and the removal of the residuary ash from the furnaces presents small difficulty compared with the masses of clinker from ordinary power-station boilers. But this finely ground ash does undoubtedly tend to adhere to boiler tubes and needs frequent removal. There is also another effect to be considered. Low-grade fuels vary considerably in carbon content, and this fluctuation is greatly increased if it be desired to use either anthracite or bituminous fuel in the same boiler. It is the carbon content that demands the oxygen supply for proper combustion; it is that which, to an overwhelming extent compared with the other constituents of the fuel, causes a variation in the volume of air necessary. This difference alone is quite sufficient to make a formidable difference in the most suitable size of furnace for either fuel for the following reason. The different velocities of the gases generated in the two cases flowing through the various tube passes will, as in the case of the oil-fired boilers quoted above, have little effect on efficiency beyond the deposition of fine ash on the tubes; but if the boiler is designed for bituminous fuel the greater gas velocity when using anthracite may tend to affect the brickwork of the furnace unless the velocity is restricted to something very considerably less than that usual in coal or oil-fired furnaces owing to the scouring effect of the entrained ash. This is one of the principal reasons for the necessity of adopting very spacious furnaces for pulverised fuel. The corresponding effect when burning coal is not present, as the ash remains on the grate, and the question does not arise when burning oil. With the latter, however, brickwork troubles are very apt to arise if the flame impinges directly on the bricks, but as long as this effect can be avoided the gas speeds can be high. The carbon content with oil is not so great as with coal, as the hydrogen element is much greater; the air required per pound is more than with bituminous but less than with anthracite fuel.

Furnace Volume and Boiler Design.

This question of furnace volume has a very interesting bearing on the boiler design as a whole. To start with, the size required entirely prohibits any possibility of using pulverised fuel on board ship. Ashore, where the space factor is of less importance, it is necessary, with these enormous combustion chambers, to utilise as much of the heat generated as possible by immediate radiation in order to avoid any tendency owing to the large exposed surface of the containing walls to the cooling of the furnace gases. However well built and bricked these may be and however well backed the fire wall bricks may be by non-conducting brickwork, experience in similar designs has shown that there is always the possibility of this cooling effect with these large extended furnaces. There are further objections to them in the large mass of brickwork involved, for unless plated externally, they are very apt to allow air to leak through into the furnace. In lighting up a very large furnace from cold—the one at Delaware referred to above has a front furnace wall of practically 700 square feet and over 20in. thick—twenty-four to thirty hours pass before this brickwork is properly heat saturated; that is to say, that a material portion of the heat generated in the furnace is devoted solely to heating up the boiler brickwork to its proper working temperature. A certain amount is recoverable, it is true, on shutting down again, but large exposed furnace surfaces must add to the loss from radiation. Compared with the large oil-fired boilers mentioned, the total exposed surface of which consists of a bottom about 20ft. by 10ft., and a back of less than half this area, the total brickwork exposed is enormous. The front of these oil-fired boilers is practically entirely taken up with the oil burner boxes and the radiated warm air is forced into the furnace. One can raise steam very rapidly without damage to the metal portions; the warming up of masses of brickwork needs both care and patience.

In the average "marine type" Babcock and Wilcox boiler, whether fitted for land or ship duty, the combustion chamber space above the fire-bars and below the tubes runs from about 3.5 to 5 cubic feet per square foot of grate, the former being usual on board ship. For oil firing, the total height of boiler is not increased, but the combustion chamber bottom is dropped to the floor level, giving about 5.5 to 8 cubic feet per square foot of furnace floor. In inclined tube boilers the amount is about 5 cubic feet, but varies considerably with the inclination of the tubes and the amount by which the furnace bottom is dropped below the side drums; the continued tendency has been to increase it. In a large double-ended marine boiler with four separate furnaces at each end, such as is found in a large Atlantic liner, the combustion space measured above the fire-bars is roughly 2 cubic feet per square of grate in the furnaces proper, and about 3.5 to 4 cubic feet in the combustion chamber. For the same total amounts of fuel consumed—not amounts per square foot, as the bigger grates of the water-tube boilers vitiate the comparison—the ordinary steaming rate in marine work averages somewhere about 4 lb. to 6 lb. of coal per cubic foot of combustion space with low draughts, and in the case of closed stokeholds from 7 lb. to 8 lb. In the Delaware boiler, for normal working, the combustion will not attain even 1 lb. per cubic foot or for overload capacity little more than 1.75 lb. The furnace height from grate top to front row tube top is 25ft.; from grate bottom to lower end of tube is fully 12ft. It is very clear that these furnaces are not restricted in volume. The process of combustion with pulverised fuel, however, demands large volumes; the action of combination and the propagation of flame is entirely different from that met with in the case of oil or coal fired. An oil flame starts within a few inches of the burner and is kept at a distance by the velocity of the oil injection and the fact that until the spray is well clear of the burner orifice there is insufficient air to support combustion. If there was, and the flame ran back to the burner tip, these oil nozzles would soon burn away. In the case of a coal grate, depending on the nature of the fuel, part of the air flows through the fuel bed and part over the top; insufficient of the latter to support combustion in the furnace was the cause of the excessive flaming at the funnel tops so often experienced in warships of all types in the days of coal firing. The hot gases coming into contact with the oxygen in the air at funnel top burst into flame there; it was not a continuous flame all through from the combustion chamber. But some fuels of low quality will only light when subjected to flame on account of their slow self-igniting properties, and in these cases special furnace arrangements are necessary to obtain reverse flame action in order to facilitate ignition. When such a design is essential the high furnace gas speeds permissible with other fuels become impracticable, and the result is that furnaces of very large capacity are required. To absorb efficiently the heat generated under these circumstances, a greater proportion must be transmitted by radiation and less by conduction.

* "Proceedings," Lit. and Phil. Soc., Manchester.
† "Proceedings," Institution of Mechanical Engineers, October, 1909.

‡ See "Transactions," I.N.A., 1912, "Trials of an Oil-fired Boiler," by Mr. Harold Yarrow. Also "Marine Boilers," by Babcock and Wilcox, Limited, 1914.

Railway Matters.

THE contract for the Clydach, Pontardawe and Cwmgorse Railway, referred to in this column on June 30th, has been let to Walter Scott and Middleton, of Westminster. This firm did that portion which was completed before the war. The line will pass through a rich and undeveloped anthracite field, and will cost about £500,000.

THE collision of the 5th ult., at Sulphur Springs, on the Missouri Pacific, by which thirty-seven lives were lost, was caused by the driver of the second train ignoring a stop signal and a distant signal which were against him. He had, moreover, a view of the standing train, 2254ft., before his engine struck it. He was travelling at about 40 miles per hour at the time of the collision and apparently, when near the other train, he saw it, applied his brakes and jumped. He was amongst those killed.

ON page 304 of our issue of March 17th, and again on page 359 on March 31st, we referred to the 100 locomotives built at Woolwich at a total cost of £1,600,000. This matter has now been the subject of criticism by the Select Committee on Expenditure. The sum there given is £1,300,000, which, it is said, was provided from general balances, first of Ministry of Munition's funds and, later, of Army funds, and that "moneys provided by Parliament were irregularly used to finance a commercial undertaking for which no Vote had been taken."

IT is announced that for the electrification of the Paris-Orleans line eighty electric locomotives of 1720 horse-power each have been ordered from the Société Française Oerlikon, Paris. These locomotives are to be built to the designs of the Oerlikon Company in the factories of its French branch at Ornans. The five first engines, which are to serve as models, will be built in the Swiss works. Among the four trial locomotive types, ordered in a competition for the Paris-Lyons-Mediterranean line, is an Oerlikon express engine of 2300 horse-power, which was partly built at Oerlikon and partly at Ornans.

SPEAKING on the 15th ult., at the unveiling of the North Staffordshire Railway war memorial, Lord Anslow, the chairman of the company, said "There are great changes ahead of us, and the time is rapidly approaching when, for some of us, the close and intimate associations of many years may be broken up in the great amalgamation of a new and extensive group. It was not of our seeking. It is, to a great extent, a sad but necessary consequence of the war. We can, however, confidently rely on North Staffordshire men and women who follow after us, with reverent hearts and loving hands, to watch over this memorial of gallant service and patriotic deaths. We can trust this memorial to them."

THE provision of a "booster" to the tracking wheel of a locomotive is now recognised in the United States as a practical proposition. The Delaware and Hudson, under patents taken out by its general superintendent of equipment and way and general manager, has since provided a reciprocating steam engine and coupling-rod to drive the four wheels of the rear bogie of an engine tender. Incidentally, this converts the weight of the tender into a means for obtaining additional tractive power. The "booster" can be cut out as required, and cannot be opened except when the engine regulator is in use. Tests on the road showed that a locomotive so equipped could take 2477 tons, as compared with 1650 tons, an increase of 48 per cent.

ACCORDING to the Board of Trade returns, the value of the railway material exported during the first six months of the present year was as follows, the corresponding figures for 1921 and 1920 being added in brackets:—Locomotives, £2,992,504 (£3,459,385, £2,377,890); rails, £1,525,330 (£1,793,057, £916,721); carriages, £860,791 (£815,260, £677,175); wagons, £2,033,145 (£3,057,041, £2,737,934); wheels and axles, £746,387 (£1,115,857, £961,355); tires and axles, £239,973 (£806,866, £636,815); chairs and metal sleepers, £1,224,924 (£735,862, £314,244); miscellaneous permanent way, £824,512 (£1,467,742, £1,135,674); total permanent way, £4,670,121 (£6,070,950, £4,010,874). The weight of the rails exported was 147,332 tons (81,319 tons, 49,783 tons); and of the chairs and metal sleepers, 88,805 tons (29,656 tons, 14,981 tons). Locomotives to the value of £57,550 were shipped to India during June, 1922, and of £15,675 to the Argentine.

THE accident to a lorry at Swansea, which we mentioned herein on June 30th, has been inquired into by Major Hall. The railway belongs to the Swansea Harbour Trust, and the road is the property of Lord Jersey. Under the Act of 1901, sanctioning the railway, there is an obligation on the part of the Trust to build and maintain a bridge, and from that year to 1914 correspondence went on between the Trust and Lord Jersey as to the position of the bridge. Nothing had been decided up to the latter date, and now, as we read Major Hall's report on the accident, other issues have arisen. That officer recommends that the erection of the bridge be proceeded with, and that meantime a loud sounding bell shall be placed at the crossing, and crossing signals fixed on the roads at the approaches to the crossing.

THE sharp curves approaching Craigellachie from the south of the Great North of Scotland Railway are known to many of our readers. From mile 66 to Craigellachie, 67¾ miles, one curve follows another in close succession on radii of 10 chains, and near mile-post 67, about the middle of one of the right-handed curves in the direction of travel, a goods train was derailed, on June 8th, in consequence of a broken rail. Major Mount inquired into the accident, and in his report, just issued, he says that the whole of the permanent way at this point for a length of 300 yards is some 31½ years old. The rails originally weighed 80 lb. per yard, and now weigh, roughly, 72 lb. The railway company considered that, having regard to the traffic, the age of the track was not excessive, yet, but for the war, it would have been renewed two years ago. Major Mount recommended that instead of the speed limit of 30 miles per hour being applicable to this particular length, it should govern the whole of the 3¾ miles between Dufftown and Craigellachie, and that twelve sleepers instead of eleven should be used for coach rail length—30ft.

Notes and Memoranda.

ACCORDING to the report of the Mines Department of the Malay States, the china clay works at Gopeng, in the State of Perak, were brought to the producing stage during 1921, and a good market has been found in India. The works produce firebricks of good quality, and will shortly be in a position to put on the market pottery of all kinds

THE wireless telegraphy station at Madras is to be converted into a high-speed automatic plant for working inland and to Rangoon. The Rangoon station will normally replace the present land lines and cables between Calcutta and Rangoon for traffic between India and Burma. The existing apparatus for communicating with ships is to be replaced by a small station to be erected near St. Thomas Point, which will render the working with ships easier than hitherto, and at the same time free the big station in Madras for inland work.

THE scheme for the improvement of Walfish Bay, South-West Africa, provides for a wharf 1000ft. in length, an approach to the channel 500ft. in width, with a depth of 30ft. at low water, and a channel in front of the timber wharf 800ft. in width, dredged to a depth of 33ft. The scheme is estimated to take from two to two and a-half years to complete from the commencement of dredging operations. It is not expected that difficulty will be experienced from silting. The total estimated cost is £599,500, including timber wharves £60,000, dredging entrance to the channel £262,500, bucket ladder dredger with two steam hoppers, £176,000, together with interest during construction.

AT the Salt Lake City experiment station of the American Bureau of Mines, a study has been made of the "stage education" theory in the distillation of oil shale. It has been claimed that it is possible to produce, by distillation from oil shale, a series of crude oils which vary greatly in specific gravity, the light oils being produced first at the lower temperatures and heavy oils at the end of the distillation at the higher temperatures. The results of the study show that the difference in the properties of the oil produced at any stage of the distillation is so slight that the advantage of attempting to collect oils of greatly differing gravities, as the oils are produced from the retort, is negligible.

SCRUTINY of the trade statistics of China for 1921 discloses the fact that in 1921 imports from Great Britain into China showed a considerable increase, amounting to 18.2 million taels, but that exports to Great Britain from China declined 14.9 million taels in value as compared with the previous year. As regards Japan, imports into China fell off by 18.8 million taels; exports to Japan, on the other hand, advanced 30.2 million taels. Imports from and exports to the United States registered enhanced values in both directions, the increase in imports amounting to 32.6 million taels and in exports to 22.4 million taels. German imports into China rose from 5.4 million taels in 1920 to 13.3 millions in 1921, while exports to Germany likewise increased during the same year from 1.8 million to 6.8 million taels. The value of the Haikwan tael, which varies considerably from time to time, is now about 3s. 6½d.

IN a lecture on the timbers of India and Burma, given to members of the Indian Legislature at Delhi, reference was made to the pyinkado or ironwood of Burma. The lecturer stated that "had pyinkadc been found in America the whole world would have heard about its marvellous qualities of hardness and durability, which outlasts that of teak." One authority, Colonel Blake, who at one time was Commissioner of Moulmein, said:—"There is a piece of pyinkado which supported a teak figure of Gautama, taken from Rangoon in 1826. The teak figure has long since mouldered away into dust, but at the pillar I fired a rifle shot at 20 yards distance. The ball was thrown back making no penetration whatever. If the figure in teak had long since mouldered away into dust, how old must the pillar of pyinkado have been?" The weight of pyinkado is given by *Indian Engineering* as being 60 lb. per cubic foot.

CONSIDERABLE time has been spent by the United States Bureau of Mines in the experimental refining of shale oil naphtha. The work evidently confirms the finding that 70 per cent. sulphuric acid is of the most effective strength for use in refining the naphtha from this particular oil. It was also found that the scrubber naphtha recovered from the activated charcoal absorber is of extremely good quality, although it is slightly over 30 per cent. saturated. Its colour is only slightly darker than water white and appears to be permanent. An important fact brought out in refining studies is that the spirit obtained from the crude oil is deficient in the more volatile fractions. In order to make it meet present-day specifications, it would be necessary to blend with it some lower boiling material, which can probably be obtained by scrubbing the retort gases. For this purpose activated charcoal seems much more satisfactory than ordinary oil scrubbers, but before this fact is definitely established some experimental work must be done.

WRITING on babbiting motor bearings in the *Westinghouse International*, Mr. J. S. Dean says:—Experience has shown that a perfectly good metal can be made practically worthless for bearings by allowing it to become too hot, also by pouring when too hot or too cold, this being more applicable to a lead base than to a tin base alloy. In order to maintain temperatures at the proper values a thermocouple connected to an indicating millivoltmeter, which is calibrated in degrees Centigrade or Fahrenheit is inserted in an iron tube which is placed in the molten metal. A further development of this scheme involves the use of an automatic attachment which controls the temperature by regulating the flow of the gas. This arrangement is very reliable, and once adjusted it requires no further attention as it works automatically. A new type of soldering pot in course of development is heated by electricity and equipped with automatic temperature control. The temperature is controlled by means of a chemical contained in a metal tube anchored in the pot, the chemical changing from an insulator to a conductor between a pre-determined range in temperature.

Miscellanea.

WE hear that the experimental locomotive equipped with a Ljungstrom turbine has recently been put through a series of tests on a Swedish railway, and on a dynamometer bed, with highly successful results. The thermal efficiency of the locomotive is stated to be as high as 14 per cent.

WE are informed that Dr. H. S. Hele-Shaw, F.R.S., has consented to succeed Captain H. Riall Sankey, as President of the Association of Engineers-in-Charge, for the 1922-23 session. This is the second time the Professor has been President of the Association, he having occupied the chair in 1912-13. The Presidential address will be delivered in October, and due notice will be given of the date.

IN connection with the conversion of the Bombay telephones to the automatic system, the Bombay Telephone Company has placed a contract for the exchange equipment of 11,000 lines, costing approximately £180,000 The installation is expected to be completed in two years. The contract for the instruments, which will probably amount to another £50,000, has not yet been placed.

ON the occasion of the Lyons Fair in the spring of next year, the East Central District Office of Agriculture, has decided to organise public trials of tractors driven by gas engines using gas of a low calorific value, such as that generated from wood, charcoal, &c. Lorries, domestic motors for farms, and small motors driven by petrol, electricity and every kind of motive power, will also be seen at the fair.

ACCORDING to the *Taegliche Rundschau*, the trial trip of the new German cable steamer, *Norderney*, took place on August 17th, at Wilhelmshaven. The vessel's displacement is about 2000 tons, her speed 10 knots, and she is capable of carrying 1100 tons of cable. In addition to wireless, the *Norderney* is also fitted with submarine signal apparatus. The new vessel replaces the cable steamer *Grand Duke of Oldenburg*, which was surrendered to the Allies.

WE have received the first number of a new monthly publication, which, we are assured, is the only technical journal in the Russian language which deals with the problems of mechanical transport and allied subjects. It is called *Mechanical Transport*, is published from 88, Bishopsgate, and is intended for distribution in Russia, Siberia, Poland, Finland and the Baltic States. With the exception of the titles of the illustrations, it is printed throughout in the Russian language.

ARRANGEMENTS are understood to have been made for the dispatch of a number of old British warships to Germany for breaking up. As it is understood that the policy of the Admiralty has lately been to refuse offers for the purchase of old ships to be broken up in Germany, it would appear that the vessels would have been among those sold some months ago. As partly explaining the keen demand of Germany for old tonnage, it is reported in shipping circles, that Germany is now finding a ready market for some form of scrap metal in Russia.

AMONG the latest measures of the Spanish Industrialists to keep up their commercial propaganda in South America, is the foundation of a Spanish-American society at Barcelona. This body consists of two sections—one economic, the other financial. The Casa de América, at Barcelona, also endevours to encourage Hispano-South American business relations. In this connection, the Casa has strongly supported the steps taken by the Italian Submarine Cable Company to obtain authorisation to anchor on the Spanish Mediterranean coasts and at the Canary Islands a cable which it intends to lay between Italy and South America. This request is now in the hands of the Minister of State, who will shortly give his decision.

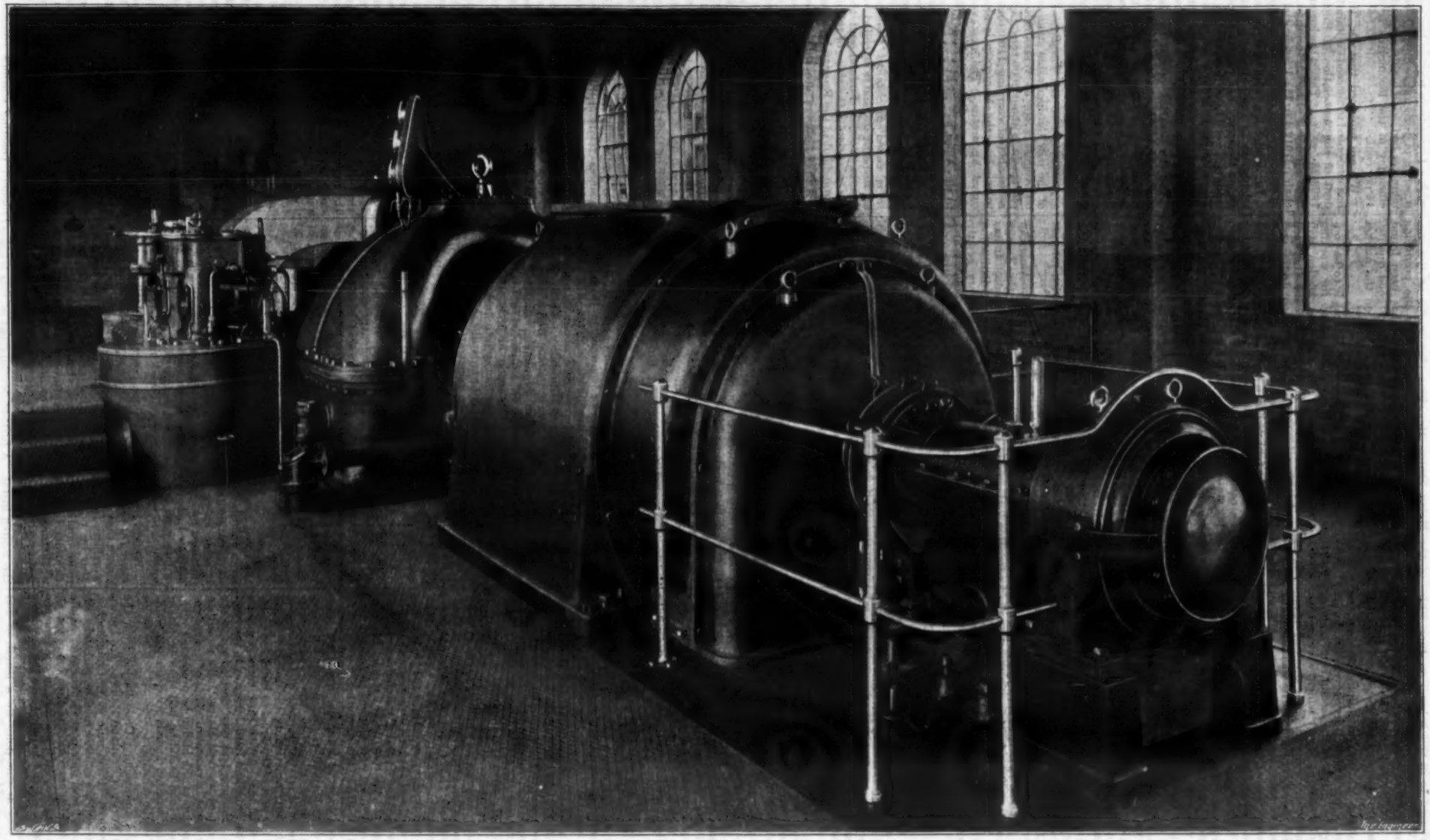
IN an article on "Dredger Buckets," appearing in the July-August issue of the *Edgar Allen News*, Mr. W. A. Longden says the parts most subjected to wear are the lips, the eyes in the base, and the hinge pins. Where possible, these are all made of manganese steel, as it has been found that this material, owing to exceptional wear-resisting qualities, combined with toughness, is the most suitable for the purpose. These renewable wearing parts should be as far as possible interchangeable, to enable replacements to be made with the least possible delay. It will be readily understood, the author states, that the time lost in waiting for repairs and renewals, should the material be faulty, might result in a possibly serious delay to dredging operations. A defective connecting-pin, for instance, would be quite sufficient to let all the buckets down and throw the dredger out of commission for some considerable time. Further, the designs must be of a simple character, because dredgers often operate in parts of the world where means of adjustment, replacements, &c., are exceedingly limited.

THE Calcutta correspondent of the *Times Trade Supplement*, states that the Government of India has issued a statement on their scheme for the development of wireless communications in India. Though the scheme does not cover wireless communications with Britain and other parts of the world, the policy outlined is such as to fit in eventually with the Imperial wireless scheme approved by the British Government. The Government of India under its scheme is to have the exclusive privilege of erecting, maintaining, and working wireless telegraphs in British India, and will exercise the right by maintaining stations open for public traffic and by granting licences to private bodies to erect and work wireless in British India and in ships and aeroplanes registered therein. Besides a number of portable and semi-fixed stations of small power and the stations on the Sandheads pilot vessels, it will maintain several permanent coasting stations communicating with ships at sea, comprising Bombay, Calcutta, Diamond Island, Karachi, Madras, Port Blair, Rangoon, and Victoria Point. The inland stations are Allahabad, Delhi, Lahore, Maymyo, Mhow, Peshawar, Quetta, Secunderabad, Patna, and Poona. Half the business of coast stations is at present occupied by inland station messages at the large ports and important cities. It is, therefore, essential to relieve them by separate stations, and the plan is to provide separate inland and coast stations at Rangoon, Bombay, Calcutta, Madras, and Karachi.

3000-KILOWATT TURBO-GENERATOR AT PARK GATE IRONWORKS

THE METROPOLITAN-VICKERS ELECTRICAL COMPANY, LIMITED, TRAFFORD PARK, MANCHESTER, ENGINEERS

(*For description see page* 216)



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TWO-PAGE SUPPLEMENT—THE PARK GATE IRONWORKS NEAR ROTHERHAM.

THE ENGINEER.

SEPTEMBER 1, 1922.

Light Railways.

WHAT an instance of blasted hopes does our light railway policy present! Launched in 1896 as a remedy for agricultural depression, with a vote of one million sterling to back it up, its influence rapidly diminished. In 1896 the Light Railway Commissioners dealt with 256 applications for 2656 miles and an estimated expenditure of eighteen millions in less than four years; but during the next twenty-odd years only 456 applications, proposing the construction of 2495 miles and an expenditure of twenty-four millions, were received. Of the total of 712 applications for the twenty-five years, 482 were approved, 124 were rejected, 97 were withdrawn, and 9 were deferred. From the annual report of the Commission for 1918 we learn that up to that time only 900 miles had been constructed, of which 550 were light railways as usually known, and it is significant that 325 of the 550 miles were made by railway companies. Of the one million pounds at the disposal of the Commission for advances, only £203,000 had then been advanced and £178,000 promised. It is important to remember, too, as indicative of the high hopes at one time entertained, that, because of the good work it was doing, the Commission was re-appointed when its five years' limit expired; in fact, it remained in office until February last, when it ceased to exist in accordance with Section 69 (1) of the Railways Act of last year, whereby all its work was transferred to the Ministry of Transport. This fact, and the valedictory report of the Commission recently issued, together with the report of the Light Railways (Investigation) Committee, issued a couple of months or so before the Commission went out of office, suggest that it is desirable that consideration should be given to the causes that have led up to such disappointing results, and to what, if anything, can be done to make British light railways as successful as are those of Belgium and France.

It was in January, 1895, that a committee was appointed to consider: (1) How far the usual requirements of the Board of Trade as to constructing and working new railways might fairly be relaxed, especially in the case of lines built through sparsely populated and agricultural districts; and (2) whether additional legal facilities for obtaining powers to construct tramways and light railways were necessary or desirable. This committee reported that practically no light railways had been constructed under the general Acts of 1864 and 1868, and that the failure was in part due to the fact that any scheme necessitated the consent of all the landowners and persons interested and required also the absence of opposition from railway and canal companies. The committee went on to say: "This lack of progress in rural districts has also been in great measure due to the want of latitude left to the Board of Trade by law and, in other cases, by the conditions which the Board considered it their duty to impose for the public safety." A Bill was introduced to carry into effect the committee's report, but the defeat of the Rosebery Government in June, 1895, prevented its being proceeded with. Mr. Ritchie, however, subsequently brought in a Bill, which became the Light Railways Act of 1896, and under it the Light Railway Commission was set up. All Orders made by the Commission had to be submitted to the Board of Trade for confirmation; but, when confirmed, an Order had all the authority of an Act of Parliament, even to the compulsory purchase of land, hitherto one of the stumbling blocks. The other main obstacle—the opposition of railway companies—however, remained, for Section 9 (3) said: "If the Board of Trade on such consideration are of opinion that by reason of the . . . effect thereof on the undertaking of any railway company existing at the time . . . they shall not confirm the Order." As to this clause it may be remarked that the before-mentioned final report of the Commission said that the development of light railway systems would, without doubt, have attained larger dimensions but for the objections of existing railway companies, whose undertakings would have suffered from the abstraction of local passenger traffic. The Light Railways (Investigation) Committee, the chairman of which was Sir Alexander Gibb, thought that the statutory provisions which preclude the Light Railway Commission from carrying any Order beyond the provisional stage and require it to submit every such Order for confirmation, have rendered the procedure, as a whole, more cumbersome and costly than it need be. There have been weaknesses of finance also. The power of the Treasury to make a loan was conditional on a local authority having also agreed to make a loan, and the amount of the former could not exceed that of the latter. What was worse, no advance could be made by the Treasury unless it was satisfied that a railway company existing at the time would construct and work the railway if an advance were made. The consequence of this requirement was that the light railway was compelled in effect to negotiate with main line companies possessing a greater power of bargaining, and thus were frequently obliged to accept unduly onerous terms. The Ministry of Transport Act, 1919, combined with the Railways Act, 1921, should, however, make the financial situation and the procedure easier. The Minister, under Section 17 (1) of the former, may, subject to the approval of the Treasury, make advances for the construction, improvement or maintenance of light railways upon such terms and conditions as he thinks fit, and he has all the powers of the Light Railway Commission and of the Board of Trade.

It has been suggested that much good would result if the large companies would convert some of their minor lines into light railways and let them be segregated from the parent companies and become parts of light railway groups. The growth of road motor transport is a factor that enters into the question of the future policy as to light railways, and such a move on the part of the railway companies might have a counteracting effect. It is worthy of note, however, that Sir Alexander Gibb and his colleagues seem to be surprised that light railways have been so little affected. It is, they think, significant that undertakings so situated have shown their capacity, not only to survive the difficulties created by the war, but at the same time to hold their own in spite of the new facilities which are now available. All this is very hopeful and encouraging. The need for, and the purposes of, light railways are the same as in 1896. Agriculture yet remains one of our staple industries, and any cheapening of the means of communication between the country districts and the towns is all to the good of the community in general. But a new conception of the character and functions of a light railway is both desirable and necessary. In the words of the conclusion of the report of the committee just named, existing notions with regard to the construction and operation of light railways generally are based upon experience originally gained in the construction and working of the great main lines. Main line traditions have governed and hampered the economic development of the small undertakings. Light railways should be regarded from quite a different angle. Instead of endeavouring to maintain standards of speed and service somewhat akin to those adopted by main line under-

takings, it should be recognised by all concerned that light railways are in an essentially different category and must depend for their success upon emancipation from main line conceptions of construction and operation. A lower standard of speed is a first essential, and with it the necessity for elaborate methods of construction and working would largely position of the light railway industry could be radically improved, and that without any serious disappear, with the result that the economic sacrifice of efficiency.

Fine Grinding in the Potteries.

IT is not without interest to remember that when Alsing introduced the tube mill half a century ago—to be precise, in 1870—his principal aim was its application to the grinding of calcined flints in the Staffordshire potteries. It is of interest, too, to glance at the position at the present time and see what change the intervening period has brought about in the economics of grinding the calcined flints, Cornish stone, Jersey stone, bones, felspar and other hard materials used in this important industry. Inquiry shows us that the tube mill, which has come so much into favour in other industries, among which metallurgy and cement making may be mentioned, has really made but little progress in ousting its only rival, the wet chert mill, from local favour; albeit it has the advantage in first cost. It is now not far short of 150 years since Brindley—better known in other spheres of engineering—brought out the wet grinding mill or "pan," as it is more commonly called, at the behest of Wedgwood, who had just initiated the use of flint in pottery, and one or other of them decided upon the use of chert or hornstone as the abrasive medium. It is said, and there is no reason to impugn the accuracy of the statement, that there is practically no difference in the design of the pans to be seen in operation to-day from those in use a century ago or at the time of their introduction. This is, of course a tribute to the work done rather than to any inherent conservatism on the part of the miller or potter. With regard to these terms it may be advisable to point out that only a few potters do their own grinding, which is a separate business carried out by milling firms, who buy the siliceous materials in bulk and sell them in the form of slop to the pottery manufacturers. Described very briefly, the chert grinding pan is in the form of a mortar mill, 14ft. diameter and 3ft. high, the bottom being lined with chert blocks about 1ft. thick. Over this bed four large blocks of chert called runners, fixed to four arms at right angles, revolve at a speed of 15 revolutions per minute. A common weight for these runners is 16 cwt., though much heavier stones have been used. The pulp from these mills has to pass a 140 silk or wire mesh.

We have said that the tube mill has the advantage in first cost and this statement may be elaborated by saying that it is not the mill proper which represents expense in the chert pan but the heavy gearing, a considerable amount of power being required to start and run it. Certainly almost as much is required for a tube mill of similar capacity at the start, but afterwards the power required is considerably less than with the chert mill. Turning now to the much-debated question of their relative economy, the matter cannot be regarded as settled. Those who have installed the tube mill say that it effects an economy, but this does not seem to amount to a great deal, if one may take as authoritative the statement that the saving does not exceed one shilling per ton of material ground. But in cases of this sort circumstances may arise where the recognised or established ratio of economy is upset, and a point in favour of the tube mill has been brought about by the present high price of chert. There is no need to explain that mining costs everywhere greatly exceed those of pre-war times, but it is surely a very important point for the chert mineowners to see that the price of their product does not lead to the installation of more tube mills, for there is practically no market for chert outside the pottery manufacture. A further point in favour of the tube mill is that it occupies less space than the older grinder and, moreoever, need not necessarily be put on the ground floor. Against the tube mill, however, is the heavy hand of certain potters, who, in giving out a contract for slop to the miller, specify that it must be the product of the chert pan. It will be seen then, that as long as this preference exists—and it is based on solid grounds—there is no likelihood of the chert pan being scrapped in favour of its younger rival. For some time, at any rate, we may expect to see both systems of grinding carried on in close propinquity.

It is hardly necessary to say that we have no desire to take sides in this clash of interests and conflict of opinions, and it is certainly no part of our present purpose to vaunt the virtues of the chert pan to the detriment of the tube mill. The reason why we have referred to the matter is the fact that for the first time in its long existence an important grinding mill in the Potteries has just had a tube mill erected close to its battery of chert mills, and the various verbal reports as to the relative economy of the systems will be added to, we hope, by another based on carefully recorded data. In this case the necessary facilities exist for making trials of the relative systems which may be taken as comparative and free from bias, and we hope to be in a position before very long to notice the results obtained. With regard to the flints used in the tube mills, the Staffordshire millers are, of course, in a good position, as those best adapted for the purpose are selected from the heap awaiting calcination and grinding. It may perhaps not be superfluous to add in conclusion that an important attribute of chert as a grinding medium is that its gradual wearing down does not add any deleterious foreign matter to the flint, as would be the case if certain other stones were used.

The Fuel Commission in France.

THE seventh report of the Commission d' Utilisation du Combustible, just published, deals with the methods already being adopted to a large extent for securing economies in the consumption of coal for steam raising. The bad quality of much of the fuel and its unequal distribution during the two years following the Armistice were responsible for a falling off in the efficiency of steam raising plant, and special interest was, therefore, centred in the various problems for utilising the fuel to the best advantage. There could be no drastic changes in the methods of steam raising—although the knowledge and experience acquired since then may eventually bring about improvements in installations—and for the time being all that could be done was to make the best use of what was available and secure economies by a system of control and supervision. This is only possible by means of organisation inside and outside the factories, the steam raising plants being themselves under the control of expert staffs, while the research work undertaken by outside associations will provide the data necessary for the economical running of plants.

Amongst the difficulties that have had to be overcome, apart from the irregular quality and distribution of coal, was the indifferent management of the steam generators in the majority of works, and the first thing to be done was to provide means of instruction in the art of steam raising and to create a special class of engineers and foremen capable of securing the maximum boiler efficiency. For that purpose it is proposed to increase the number of schools for giving instruction in industrial steam raising. In the second part of the Commission's report examples are given of the organisation carried out at several of the leading works. At the Forges et Aciéries de la Marine et d'Homécourt, the system consists, first, of a number of local services which carry out experiments with the fuels considered to be the most suitable for the generators of which they have charge, collect all data available upon industrial steam raising and present weekly reports upon the fuel consumption; and, secondly, of a central service that controls the local services in the different works, centralises the data and acts in a consulting capacity to the various manufacturing departments, which remain responsible for the results obtained in the management of the steam raising plants. At Creusot the organisation is particularly complete. There is, first, a section under the direction of an expert staff which deals with everything relating to steam raising economies. It prepares a programme of consumption for the different shops, verifies the weight and quality of the coal received, and distributes it according to the quality best suited to the form and character of the grates, investigates the types of generators likely to give the most satisfactory results for the different installations and centralises all the information available at home and abroad concerning systems of grates and generators. Then there is a section composed of an engineer and staff, having a laboratory of their own, which controls the working of the different batteries of generators. The quantity of coal consumed and of water evaporated is ascertained at regular intervals and the gases from combustion are analysed. Premiums are paid to the men according to the results obtained. The organisation is now complete, and the consumption of coal has been reduced by 15 per cent. At the works at Breuil of Messrs. Schneider, a scientific control of twenty-eight suction gas producers has resulted in an economy of 14 per cent. At the Aciéries de Pompey, a part of the works has been electrified, blast furnace gases are employed in internal combustion engines and for steam raising, and a systematic control is exercised by a specially formed staff. Since the collieries in the Saar basin were taken over by the State, the 720 generators, spread over an area of 50 kiloms. by 15 kiloms., have been put under expert management, with the result that in one year the temperature of the gases in the chimney was reduced from 300 to 250 deg. Cent and the percentage of carbonic gas increased from 8.5 to 11 per cent. Although a larger quantity of inferior coal was used the economy of coal consumed as compared with the amount extracted was 1 per cent., so that the total economy for the year would be about 90,000 tons.

In addition to the internal works' organisation for effecting economies in fuel consumption, there are ten steam users' associations which look after the maintenance of the plants belonging to their members. The laboratories of the Comité Central des Houillères and of the Comité Central des Cokes de France are also contributing to progress in the scientific utilisation of fuel. The greatest hopes for the future, however, are centred in the Office Central de Chauffe Rationnelle, which was formed in 1919, with capital subscribed by firms interested in coal for marine purposes, together with a subsidy from the Government. The Office Central has created several services which are under the control of a technical managing director. Those services consist, first, of a School of Industrial Heating which gives complementary instruction to engineers over a period of five weeks and essentially practical instruction to foremen, who attend the classes for four weeks. In two years the school has turned out sixty-six engineers and eighty-three foremen. The Office Central also collects the fullest possible data concerning the progress of industrial heating, and, while testing new methods and processes, undertakes to prepare plans for the transformation of existing plants and for the installation of new ones. It has a laboratory for analysing gases from combustion and for adjusting pyrometers, gauges, and other apparatus employed for verification and control. Its engineers are at the service of manufacturers who need advice upon any matters relating to fuel economies, whether in steam plants or in suction gas producers, and an active propaganda in favour of fuel economies is carried out in many different ways. According to the Commission's report, the economies realised in works as the result of the operations of the Office Central, notably by the instruction given to engineers, has ranged from 10 to 25 per cent., while in certain exceptional cases of suction gas plants the economy has been as much as 60 per cent.

In conclusion, the report points out that there can be no general rule to govern the organisation of the fuel economy service in a works, which must be adapted to circumstances, and should be based upon the successful methods employed elsewhere. Even in the big works, where the organisation is complete and self-contained, there is every advantage in a close collaboration with external services, such as the Office Central de Chauffe Rationnelle. Those external services are being rapidly developed for the benefit of steam and other power users generally, and by popularising the idea that greater boiler efficiencies can be obtained by means of a better knowledge of combustion and an expert supervision, the Commission affirms that it is possible to realise still more important economies.

Literature.

Navigation Intérieure: Canaux. Cours Professé à l'Ecole Nationale des Ponts et Chaussées. Par O. JACQUINOT, Inspecteur-Général des Ponts et Chaussées. Revu avec la collaboration de F. GALLIOT, Inspecteur-Général des Ponts et Chaussées. Paris: La Librairie J.-B. Baillière et Fils, 19, Rue Hautefeuille. Price: Stitched, 45f.; in limp covers, 55f., plus 10 per cent. for carriage.

THERE is probably no public works service in the world which is more efficient, or has a larger accumulation of experience and precedent of its own particular *genre*, than the Inland Waterways Division of the Service des Ponts et Chaussées of France. Two distinguished members of this service have collaborated in the production of a volume on the construction and maintenance of canal navigations. The monograph is mainly the work of M. Jacquinot, an Inspector-General des Ponts et Chaussées, who was for many years in charge of the Marne and the Saône Canals, and later of the inland waterways between Paris and Belgium. Ill-health prevented the completion of the work by the author; but his colleague in the service, M. F. Galliot, undertook this duty and carried out a general revision of the original text. The authors have confined themselves in the main to the production of a comprehensive *résumé* of the practice obtaining in the French service in connection with the construction and maintenance of artificial inland waterways, drawing upon French sources for the majority of the examples of construction which are illustrated and described. Perhaps the most valuable part of their work, and one which is too frequently

absent from books of this description, consists of the chapters devoted to the principles which underlie and govern the location and design of canals and of their accessory works. We have not noticed in our perusal of the volume any points dealing with French canals which seem to merit serious criticism. On the contrary, these parts are very complete and contain a vast amount of valuable information. When, however, the authors make reference to canal works in countries other than their own, the descriptions are not so good, and the omissions of matter which should find a place in a work of this nature are conspicuous. Practically no attempt has been made to describe the canal systems of, and methods of construction adopted in, other countries than their own. It would have been valuable if readers had been able to compare examples of canal practice in Belgium, Germany and the United States, to mention a few only of the countries where much recent canal construction has been carried out, with the examples of modern French practice, and to have the views of the authors on the many differences in practice which exist. Again, some of the statements which are made as to works outside of France are incorrect, and the information is by no means up to date. From this criticism we should exempt the chapter dealing with the construction of canal storage dams, which, compared with other sections of the work, deals adequately with such structures in all parts of the world.

In the chapter on lock sluices there is hardly any mention of modern work of this nature in America and in Germany, and we notice that the sketch of the joint in the great cylindrical sluices on the Panama Canal on page 355, in illustration of a very brief reference to the subject, is incorrectly drawn and fails to indicate the particular feature which it is supposed to represent. Again, the chapter on hydraulic boat lifts and inclined lifts is very much out of date; the well-known lift at Anderton, on the river Weaver, is briefly described as an example of lifts operated by hydraulic power, and no mention is made of the reconstruction of this work, which was completed in the year 1908, when the whole of the hydraulic gear was removed and replaced by balance weights and electric lifting gear. Mention is made of the old hydraulic lift at La Louvière, on the Canal du Centre in Belgium; but there is no reference to the three somewhat similar lifts on the same canal system, which were in course of construction before the war, and have been completed since the Armistice and are now in service. Inclined planes are referred to at some length, but the best-known example of this form of lift—the now derelict Foxton lift on the Grand Junction Canal—is not mentioned, neither is there any reference to two of the most recently constructed vertical lifts, viz., that at Henrichenburg, on the Dortmund-Ems Canal, and the Peterborough lift in Canada, the latter completed in 1904.

The authors' conclusions on the vexed question of locks *versus* lifts as a means of surmounting considerable differences in level are, on the whole, unfavourable to the latter expedient, and, in agreement with the opinions of the majority of canal engineers who have published their views on this matter in recent years, they have come to the conclusion that, generally speaking, locks of high lift are to be preferred to any form of inclined plane or balanced lift. The authorities quoted in support of this view are, however, not of recent date, and the authors could, we think, have strengthened their exposition of the subject by reference to the published views of experts more recent than a quarter of a century ago.

Of the seventeen chapters into which the work is divided, the most complete and useful are the first ten, which cover such subjects as the determination of cross sections and profiles, provisions for ensuring water-tightness, the construction of canal banks and the stability of cuttings and banks. An interesting chapter is devoted to the construction of canals in country liable to floods and in proximity to river courses. The chapters on water supply are excellent and deal, not only with means for securing an adequate supply, but also discuss in detail the consumption of water by traffic operation and in losses from various causes. The chapters on aqueducts and on reservoir dams of earth, masonry and concrete are the best of those devoted to descriptions of works. Several of the remaining chapters, particularly those on locks, gates, lifts and inclined planes, do not reach the standard of the remainder of the work, and, as we have already indicated, are neither up to date nor do they deal adequately with modern practice in countries other than France. The two last chapters are devoted to traction on canals and maintenance. The first of these would have been improved by the inclusion of references to recent work in this connection of which the authors are probably aware. As to the last chapter—on the maintenance of canal works—we would that M. Jacquinot had made this longer and dealt more fully with a branch of his subject about which there is but scanty information available in a published form. His ripe experience could have made this section one of the most valuable in the book. It should perhaps be noted that ship canals, as distinct from barge canals, are not included in the authors' range of subjects.

Our criticisms are not intended in any way to detract from the value of MM. Jacquinot and Galliot's work as an exposition of French canal practice and principles of design; but if, as is probably the case, the authors planned their work as a text-book to be read by students of canal construction in the Ecole Nationale des Ponts et Chaussées, it is, we think, to be regretted that the references to modern practice in other countries are so fragmentary and incomplete.

SHORT NOTICES.

The Coal Mining Industry of the United Kingdom and the Principal Foreign Countries of the World. By Finlay Gibson. Cardiff: The Western Mail, Limited. 1922. £3 3s.—This volume, which covers over 240 pages, gives a minute statistical survey of the coal industry of the United Kingdom since 1874, and of that of foreign countries since 1885. The work is divided into twelve sections. Of these, one is devoted to the output, persons employed, and output per person in all the coal-producing counties of the United Kingdom since 1874; another deals with the exports, cargo and bunker, foreign and coastwise, from the various coal-exporting centres of the United Kingdom, and the destinations of our exports; another is devoted to wages, and gives complete details of wage variations since 1875 for South Wales, and since June, 1914, for the rest of the country; while the other sections are devoted to prices, the coke and patent fuel trades, mining accidents, production, and exports in foreign countries, and the costs of proceeds of the mining industry of the United Kingdom under the national agreement of last June. It is impossible to exaggerate the value of a volume of this character to all who are interested in mining statistics; for one is enabled to trace not only the fluctuation and expansion of the production of coal in all countries, but to follow, with the greatest facility, the acquisition of foreign markets, the keenness of the rivalry between the various coalfields for a share in the trade of such markets, and the competition of other coal-producing countries consequent upon the effects of the war.

"The Electrician" Annual Tables of Electricity Undertakings. London: Benn Brothers, Limited. Price 10s. net.—Hitherto these tables have been published from time to time in the *Electrician* in the early months of the year, but they are now published annually in June. Considerable advantages will, it seems, accrue from this new arrangement, for the accounts of most of the electricity supply companies are made up to December 31st of each year, whilst the financial year of the local authorities, with the exception of those in Scotland, ends on March 31st. In the 1921 issue of the tables a new form of presenting the statistical information was adopted. The details of the generating and steam-raising plant, which were omitted during the war, were restored, and the matter was re-set in a different style. The change, which offers greater scope for adding further details as occasion arises, has, it is said, proved acceptable to all users of the tables. The information that is now given regarding the mains and distributors, converting plant, showrooms, &c., increases the utility of the tables to manufacturers, suppliers, and others, who have occasion to consult them.

The Mechanical Handling and Storing of Material. By G. F. Zimmer. London: Crosby Lockwood and Son. 1922. £3 3s. net.—This is the third edition of Mr. Zimmer's work, which first appeared in 1905, and has been very largely re-written so as to include a number of British machines not manufactured fifteen or twenty years ago. The book is principally of a descriptive character, and covers practically every class of conveying apparatus, even to the extent of including such specialised cases as pig iron casting machines. There are, every here and there, a few historical notes, and in one of these Mr. Zimmer has, we think, made one of the only slips in the volume—and it covers over 800 pages. In describing the coaling of a steamer at Nagasaki, he says that the coolies carry the coal in baskets on their heads. As a matter of fact, the baskets are always passed from hand to hand, which accounts for the very rapid rate at which coal is handled in Japan. Besides the coal itself, the only things moved are the light baskets and the porters' hands.

Metal Cutting Tools. By A. L. De Leeuw. New York: The McGraw-Hill Book Company. 1922. 15s. net.—This book, which first appeared in the form of a series of articles in the *American Machinist*, is of topical interest on account of the controversy on the cutting action of lathe tools, and commences with an explanation of the phenomena involved in the formation of chips, in which it is pointed out that the action of a rough-turning lathe tool is analogous to that of a razor. The greater part of the volume, which includes over 300 pages, is devoted to the detailed description of all kinds of tools, from a simple lathe tool to elaborate milling cutters. The author gives a description of a special tool for lathe work, which, he says, could be used at a cutting speed of 1425ft. per minute, and removed 0.2 carbon steel at the rate of 61 cubic inches per minute. The book is well printed, well illustrated and full of useful information.

Boiler Plant Testing. By David Brownlie. London: Chapman and Hall. 1922. 10s. 6d. net.—As might be expected from Mr. Brownlie, this work is of a distinctly controversial nature, and sets out to show how wrong are many people in their assertions concerning boiler plant performances and testing. It must be admitted, however, that there is much truth in the author's contentions, and in any case his manner of putting forward his ideas emphasises them, while tending towards a personal analysis on the part of the reader. The book is divided into four distinct sections, the first of which gives an account of the results at present being obtained on boiler plants in general, based on the author's experience; the second criticises existing codes for testing boilers, and specially that recommended by the Institution of Civil Engineers. The third section gives Mr. Brownlie's ideas of a code; while the fourth contains the design for a set of the most elaborate report sheets.

A Practical Treatise on the Metals Used in Marine Engineering. By W. H. Colpitts. Glasgow: James Munro and Co. 10s. 6d. net.—In this book brief sketchy accounts are given of the processes employed in the production of the metals ordinarily used by engineers from their respective ores. The information given is intended to assist students in answering questions asked on metallurgy at the Board of Trade and similar engineering examinations, and is of a practical rather than a theoretical nature. The illustrations are mostly crude sketches and indifferent reproductions of photographs.

Practical Refrigeration for Marine Engineers. By H. E. Roberts. Glasgow: James Munro and Co. 4s. 6d. net.—A little book palpably written by one who has had long personal experience with refrigerating machinery. The plant used for the several systems of refrigeration is described, and hints are given on its proper maintenance, while there is a chapter on the receiving and stowing of refrigerated cargoes.

The Engineering Workshop Handbook. By Ernest Pull. London: Crosby Lockwood and Son. 1922. 3s. 6d.—A useful book of some 170 pages and of the type for which Mr. Pull is well known. In it there is most of the information which is likely to be required by a mechanic or foreman in the course of his daily work in an engineering shop, and the volume is of such size that it can easily be carried in the pocket. In the present fifth edition there are new chapters on precision grinding and on tapers and taper turning.

BOOKS RECEIVED.

The Birmingham Exchange Directory of Members, Subscribers, and Representatives, 1922. Price 2s. 6d.

A Life of George Westinghouse. By H. G. Prout. London: Benn Brothers, Limited, 8, Bouverie-street, E.C. 4. Price 18s. net.

Elementary Hydraulics. By F. C. Lea. London: Edward Arnold, 41–43, Maddox-street, W. 1. Price 7s. 6d. net.

Outlines of the Calculus. By Terry Thomas. London: Mills and Boon, Limited, 49, Rupert-street, W. 1. Price 3s. 6d. net.

The Motor Car Index, 1922. By J. F. Atkinson. London: The Motor Car Index, 31, Essex-street, Strand, W.C. 2. Price, 10s. 6d. net.

Magnetism and Electricity. By J. Paley Yorke. New edition, completely re-written. London: Edward Arnold, 41–43, Maddox-street, W. 1. Price 5s. net.

The Journal of the Institute of Metals. Vol. XXVII. Edited by G. Shaw Scott. London: The Institute of Metals, 36 and 38, Victoria-street, S.W. 1. Price 31s. 6d. net.

Les Axiomes de la Mécanique (Examen-Critique). (Note sur la Propagation de la lumière). Par Paul Painlevé. Paris (6e): Gauthier-Villars and Cie., 55, Quai des Grands-Augustins.

The Institution of Railway Signal Engineers (Incorporated). "Proceedings," 1921. Reading: M. G. Tweedie, Great Western Railway Signal Department, 80, Caversham-road. Price 7s. 6d. net to non-members.

Reinforced Concrete: A Practical Handbook. By R. J. Harrington Hudson, with a foreword by E. Fiander Etchells. London: Chapman and Hall, Limited, 11, Henrietta-street, W.C. 2. Price 16s. net.

Notes and Sketches on Marine Diesel Oil Engines: A Manual of Marine Oil Engine Practice. By J. W. M. Sothern. Glasgow: James Munro and Co., Limited, 35–37, Washington-street. Price 25s. net.

British Engineering Standards Association, No. 108, 1922: British Standard Graphical Symbols for Electrical Purposes. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 1s. net.

British Standard Specification for Material and Constructional Strength of Chemical Fire Extinguishers. London: The British Engineering Standards Association and Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 1s. net.

British Engineering Standards Association, No. 128, 1922: British Standard Specification for Dimensions and Resistances of Bare Annealed Copper Wire for Electrical Machinery and Apparatus. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 1s. net.

Heating, Ventilating and Domestic Engineering: Advice to Intending Students as to Courses of Study. Prepared by the Education Committee of the Heating and Domestic Engineers' National Joint Industrial Council. London: W. G. Hollinworth, 38, Victoria-street, S.W. 1. Price 2d.

Advisory Committee for Aeronautics. Reports and Memoranda, No. 246: Experiments on Model Airships. By J. R. Pannell, N. R. Campbell, and G. N. Pell. June to October, 1916. London: His Majesty's Stationery Office, Imperial House, Kingsway, W.C. 2. Price 6s. 6d. net.

Aeronautical Research Committee Reports and Memoranda, No. 761 (Ae. 22): Experimental Determination of Tailplane Characteristics. By H. Glauert and I. L. Peatfield, of the R.A.E. Presented by the Director of Research. July, 1921. London: His Majesty's Stationery Office, Imperial House, Kingsway, W.C. 2. Price 9d. net.

DR. GISBERT KAPP.

We are informed by Mrs. Kapp, the widow of the late Dr. Gisbert Kapp, that in the obituary notice, published in our issue of August 18th, a mistake was made concerning Dr. Kapp's parentage. His father was not, as was stated, a German, but was a native of Trieste and a governing civil Councillor of that city. We regret that the mistake was made and are glad to take advantage of the opportunity to correct it.

The Internal Combustion Turbine.

INCLUDING A DESCRIPTION OF A PROPOSED NEW SYSTEM OF OPERATION.

By W. A. D. FORBES, R.C.N.C., A.M.I.N.A.

In a recent number of the *Revue Général de l'Electricité*—February 18th, 1922—there appeared an interesting and informative article by M. Jules Deschamps on "The Gas and Oil Turbine," in which he discusses a paper on the subject which was read in Germany by Professor Schüle in May, 1921, and which was published in the *Elektrotechnische Zeitschrift* on July 21st and 28th, 1921. Professor Schüle gives in his paper particulars of the Holzwarth constant volume type of turbine, and of the trials recently carried out, and amplifies the account given by H. Holzwarth himself in his paper read in 1920 and published in the *Zeitschrift d. Vereins d. Ingenieure*, and also gives plans of designs of such turbines having an output of 10,000 kilowatts.

M. Deschamps challenges Professor Schüle's conclusion that the constant-pressure type of gas turbine cannot succeed, and that the explosion type of Holzwarth alone has a future, and maintains, on the contrary, that the outlook for the constant-pressure type is very favourable.

Comparison of Types and Efficiencies.

M. Deschamps contends that in seeking for a solution of the gas turbine problem it is necessary continually to bear in mind the historical development of the piston type, since the principles of thermodynamics are invariable and apply equally to both the turbine and the piston engines, so that the study of the development of the one should afford a guide to that of the other. He points out that to increase the efficiency of the early piston engine the compression was gradually raised until the limit was reached, beyond which it was not possible to go without danger of premature explosion. To increase still further the efficiency by raising the compression it became necessary to inject the fuel at the end of the compression stroke, thus leading to the Diesel type of constant-pressure cycle. The same reasoning holds good for the turbine types and indicates, as the criterion of success, the employment of high compressions and the burning of the fuel under steady conditions.

The single-fluid constant-pressure turbine has the merit of simplicity, and no complicated mechanically operated valves exposed to hot gases are required. It can be worked on a sub-atmospheric cycle, and the burning of the fuel presents no difficulties, as it can be burned at atmospheric pressure in a combustion chamber lined with refractory material. The sub-atmospheric turbine possesses other important advantages; extreme lightness of construction is possible, as the maximum pressure never exceeds 14 lb. per square inch. It is also possible to cool the working parts by flushing with cold air, which can afterwards be used in the combustion chamber; also, air "leaks in" can be provided for cooling the blade roots with but slight loss of efficiency. Moreover, owing to the lower density, the frictional losses in the turbine, the cooler and the pump are greatly reduced, thus leading to a substantial improvement of efficiency. The temperature and velocity conditions are very steady throughout the cycle, and there are no sudden fluctuations such as occur in the constant-volume cycle—an important consideration, since the motor blades are subjected to high centrifugal stresses. The chief disadvantage of the cycle is that the negative work forms a comparatively large part of the total, and a big compressor is therefore necessary. Unfortunately, a piston compressor, which has a high efficiency, is out of the question on account of the bulk of the gases to be dealt with, while present-day rotary compressors have a poor efficiency if anything beyond a moderate compression is required. In the mixed-fluid constant-pressure turbine, the ratio of positive to negative work is greater than is the case in the single-fluid type, as the steam used may be condensed. The compressor required is not so big and the importance of its efficiency diminishes. The combustion chamber can be surrounded by a steam boiler which enables the radiation losses to be reduced. In dealing with the question of steam injection for diluting the working substance and lowering its temperature, M. Deschamps criticises Professor Schüle's contention that the lowering of the temperature in the Armengaud-Lemale turbine by steam injection was fatal to its efficiency, and calls attention to a paper by M. Sekutowicz before the Société des Ingénieurs Civils de France in 1906, in which it was shown in a striking manner that the injection of steam into a combustion chamber does not have any material effect on the efficiency, and permits certain advantages to be secured. This particular point has been very adequately dealt with by Mr. Norman Davey in his excellent book on the gas turbine, and Professor Schüle would appear to be at fault on this point. As M. Deschamps remarks, the trials of the Armengaud-Lemale turbine gave much interesting information, its defects have been recognised and much better results could now be obtained when operating on this type of cycle. The great objection to the mixed-fluid type is that, on account of a small percentage of sulphur which is present in the fuel, corrosion of the metal parts will most likely take place.

The constant-volume turbine is less dependent upon the compressor, as in this cycle the ratio of positive to negative work is much larger than in the constant-pressure type. The constant-volume type has the disadvantage of being more complicated owing to the mechanically operated valves subjected to high temperatures which are required to close the combustion chamber while the explosions are taking place. The pressure in the combustion chamber is continuously falling during the expansion, so that the velocity with which the gases leave the nozzles and enter the moving blades must be continually diminishing, a state of affairs that is not conducive to efficiency. Both Professor Schüle and H. Holzwarth, however, claim that the varying velocity does not materially diminish the efficiency. The gas flow through the turbine wheel is considerably different in the constant-volume turbine from what is the case in either the constant-pressure or steam turbines. For the latter the gas or steam flow is steady, whilst in the constant-volume turbine the combustion products are ejected from the combustion chambers like machine-gun fire, the pulses of the jets of gas being intermittent, of short duration, and acting like a hammer blow, as the emptying of the chamber and the flow through the wheel does not take more than one-tenth to one-twentieth of a second. The stresses on the blades are, as a consequence, much greater than is the case with steady flow A further disadvantage is that it is necessary to inject cold air for scavenging and to cool the combustion chamber walls and turbine blades; this air, which has only a small pre-compression, will therefore leave the nozzles and pass through the blades with a much lower velocity than the hot gases, which again is not conducive to efficiency. It becomes questionable as to whether it is better to inject the cold air separately or mix it with the products of combustion.

The Holzwarth turbine does not lend itself readily to a sub-atmospheric cycle, and therefore suffers a disadvantage in that the frictional losses in the turbine are enhanced and the mechanical efficiency thereby reduced. A good overall efficiency can be obtained by working on a cycle of comparatively low thermal efficiency with small mechanical losses, or by working on a cycle of higher thermal efficiency with larger mechanical losses. The turbine has a lower mechanical efficiency than the reciprocating engine, and to obtain the same, or greater, overall efficiency it is necessary for the turbine to work on a cycle of greater thermal efficiency, and it is only by making use of a better vacuum that the steam turbine has been able to rival the reciprocating engine. The Diesel engine working on a super-atmospheric cycle owes its high efficiency to the fact that the operations of expansion and compression are both carried out in this type of mechanism with great efficiency, thus giving the engine, as a whole, a high mechanical efficiency. In order to obtain an efficiency approaching that of the Diesel engine it will be necessary to work an internal combustion turbine on a sub-atmospheric cycle, and the constant-pressure type alone is suitable for such operation.

Professor Schüle gives curves in which he compares the efficiencies of the Holzwarth and constant-pressure turbines with a piston engine working on an "Otto" cycle. The diagrams given in his paper, in which thermal efficiency is plotted to a base of compression ratio, show that the curves for the constant-pressure turbine and the piston engine lie very close together, while that for the Holzwarth turbine lies distinctly above them, particularly at low compressions. From these curves Professor Schüle concludes that the efficiency of the Holzwarth turbine is greater than that of the piston engine and constant-pressure turbine at all values of the compression ratio, and particularly so for low compressions. He omits, however, to mention that the constant-volume turbine can only operate with a low pre-compression, while the constant-pressure turbine can utilise a much greater compression ratio, and that a fair comparison is not given by comparing the efficiencies obtainable at the same compression ratio; moreover, the thermal efficiency alone does not represent the whole story.

M. Deschamps remarks that the efficiency of the Holzwarth turbine which functions with a feeble pre-compression is insufficient, and that the trials have shown all that it is capable of. He hails with satisfaction the statement of Professor Schüle that its efficiency is greater than that of a piston engine of the same compression ratio as showing that the more complete expansion and diminished heat losses to the walls surpasses the disadvantage of the turbine's lower mechanical efficiency. It is difficult, however, to believe this claim, and in the absence of definite statements as to the fuel consumption per shaft horse-power available for external work, the writer considers that such a claim cannot be definitely established, and in any case such an efficiency would not be sufficient to enable the gas turbine to compete with the steam turbine.

Finally, Professor Schüle remarks that, although with the 1000 horse-power trial gas turbine good efficiencies up to 1200 horse-power were shown on the wheel circumference, the difficulty of transmitting the greatest possible efficiency to the shaft still remains, but that with the further developments of the experimental work which was contemplated there was good ground for expecting that at no distant date the Holzwarth turbine would reach as high a degree of efficiency as the steam turbine.

The Hepburn-Forbes Internal Combustion Turbine System.

As a result of some years of study of the problems involved, the writer of this article and his colleague, Mr. H. A. Hepburn, B.Sc., A.M.I. Mech. E., have proposed a new system of operation, a description of which it is hoped may be of interest, as it is based upon a new theory of nozzle action and involves the use of a novel type of pump, known as a "kinetic compressor."

In the Hepburn-Forbes system the sub-atmospheric, single-fluid, constant-pressure cycle has been adopted, as it is considered that this type of cycle yields the most promising line of development.

Attention has been directed towards the employment of greater compression ratios than are possible with a rotary compressor, and the utilisation of the kinetic energy remaining in the gases after leaving the moving turbine blades. To attain these ends it is proposed to use a kinetic compressor, in which the kinetic energy of the gases is converted into pressure energy. How this is to be done will be described later. It can readily be seen from theoretical considerations that an increase in the mechanical efficiency of the expansion part of the cycle will lead to a substantial improvement in the overall efficiency, and that this is particularly the case for the constant-pressure type of turbine. By allowing the gases to leave the turbine with sufficient velocity to enable the whole of the compression work to be carried out in a kinetic compressor it is found that there is an improvement in the overall efficiency which may amount to the order of 80 per cent. or more above that obtained when a rotary compressor is employed.

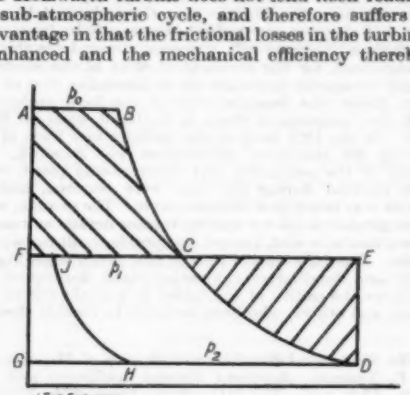


FIG. 1

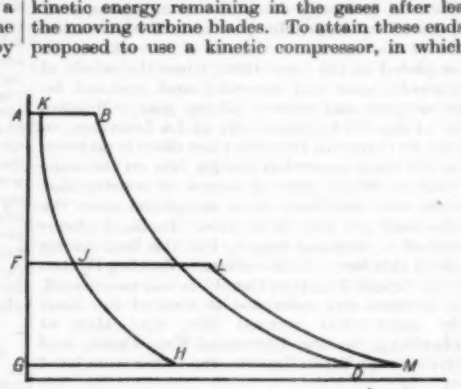


FIG. 2

Having given up the rotary compressor, it becomes necessary to produce and maintain the vacuum by other means. It is proposed to maintain the vacuum by the expansion of high-pressure gas in a nozzle system. When gas expands through a nozzle there is a tendency in certain circumstances to go on expanding beyond the back pressure. What vacuum pressure can be produced by the expansion of gas through a nozzle from a pressure greater than that of the atmosphere? The theory advanced by Mr. Hepburn and the writer is, that under favourable circumstances the expansion will continue until the atmospheric line becomes the M.E.P. line of the P.V. diagram. That is, if p_0 in Fig. 1 is the initial pressure and p_1 the atmospheric pressure, then the expansion would continue until a pressure p_2 was reached, such that the shaded area A B C F was equal to the shaded area C E D.

So far as the writer is aware, this particular relationship has not hitherto been published by others. Experimental evidence confirming this theory can be obtained from the nozzle experiments of Stodola. On page 64 of his book on "Steam Turbines"—second English edition—Stodola gives a series of curves obtained with a diverging nozzle, using steam, in which the back pressure was given various values greater than that for which the nozzle was designed. After passing the minimum section the pressure fell along the line of adiabatic expansion until a point was reached considerably below the value of the back pressure, and afterwards rose until the back pressure was reached. Assuming the above theory to be true, it will be found that the value of the minimum pres-

sure so calculated is in each case in fair agreement with the experimental result. The theory here advanced explains many interesting points concerning nozzles and orifices and the trains of waves which sometimes arise, and also points in the action of ejectors, such as the reason why a considerable drop in the initial pressure gives only a slight decrease of vacuum. It would take up too much space, however, to enter more fully into this matter, but it is suggested that it would form a starting-point for formulating a theory of the action of an ejector.

When the vacuum has been established a further supply of air, in which fuel has been burned at atmospheric pressure, can be induced to expand down to the vacuum pressure, and do work in the turbine. The gas which expands from the pressure p_2 is termed the "operating gas," and the gas which it induces to flow from the atmospheric pressure p_1 down to the vacuum pressure p_3 is termed the "induced gas." The gases, after doing work in the turbine, are cooled at constant pressure to the point H—Fig. 1—and are then compressed in the kinetic compressor back to atmospheric pressure. The amount of induced gas which enters the system per pound of operating gas depends upon the ratio of the areas A B D G and F J H G.

The sequence of operations is as follows :—Operating air is compressed in a mechanical compressor from J to K—Fig. 2. Oil is burned in a high-pressure combustion chamber from K to B. Expansion takes place from B to D, producing a vacuum in a region surrounding the operating gas nozzle, and the vacuum is transferred to the outlet end of the cooler. The induced gas in which oil has been burned at atmospheric pressure from J to L is caused to expand from L to M. The weight of gas that can be thus induced to flow down to the vacuum pressure and pass through the turbine is about four or five times that of the operating gas.

As the operating gas expands from a higher pressure it has a greater velocity than the induced gas on entry to the turbine. For this reason the operating gas alone is passed through the first row of moving blades. The operating and induced gases are both passed through the second row of blades, and on exit they mingle without shock, as they have approximately equal velocities. The temperature of the operating gas after expansion may be much lower than that of the induced gas, and the operating gas may therefore be used to give a lower mean temperature to the second row of blades.

On exit from the turbine the mingled operating and induced gases pass through the cooler to the kinetic compressor. The cooler consists of a steam boiler in which the water and steam flow in a direction opposite to that of the exhaust gases. The cooler is so arranged as to permit of the exhaust gases flowing through with a minimum reduction of their velocity. Owing to the big relative velocity between the water and steam and the exhaust gases, the rate of transfer of heat should be very rapid and very much greater than that obtained in a water-tube boiler. The power obtained from the cooler is used to operate auxiliaries, and part may be used for working a refrigerator for obtaining a supply of cold brine for surrounding the extreme end of the cooler and the kinetic compressor.

The kinetic compressor consists of a number of approximately circular chambers, each having a tangential inlet and outlet. In the body of each chamber there is a spinning mass of gas, which is kept in rotation by absorbing a part of the energy of the gas passing through the chamber. The kinetic energy of the entering gas is converted into pressure energy by the joint action of the centrifugal force caused by the constrained motion in a curved path, and the centrifugal force exerted by the spinning mass of gas. The pressure at the centre of the spinning gas is equated to that of the gas entering the chamber. If necessary, to assist in maintaining the spin of the core of the gas, blades operated by an external power source may be fitted where the velocity conditions permit.

Whether it is possible to maintain such a spinning mass of gas is a matter for experiment. If it is feasible, the writer feels confident that a solution of the gas turbine problem has been achieved. In a paper on "Flow of Air Through Nozzles," by Morley, which was read before the Institution of Mechanical Engineers in 1916, it was shown that when a jet is discharged into a room, the air in the room flows into the jet, and vortices are set up, which, once set going, continue without abstracting any appreciable quantity of energy from the jet. In the suggested kinetic compressor the kinetic energy of the spinning gas is a very small fraction of that of the gas which passes through the compressor.

If successful in action, a pump of this type has great advantages over a rotary compressor ; there is, for instance, no leakage loss and no bearing friction loss, and it would be possible to utilise much greater compression ratios. The bulk of the pump will be very greatly reduced on account of the much higher peripheral velocities employed, and it will be possible to obtain in three stages the same compression ratio which would require more than ten stages in a rotary compressor. Moreover, the simplicity of the compressor makes it exceedingly attractive. In the kinetic compressor the gas would be in a constant state of deceleration, whereas in a rotary compressor the gas is accelerated and decelerated many times in the course of compression, with consequent loss in eddies and shocks, apart from the intricacy of the path of motion.

The natural objection which occurs to anyone who has not given much consideration to the matter, is that the high velocities used will lead to big frictional losses, but a closer investigation shows that, contrary to what would be expected at first sight, these losses are not excessive. This is chiefly due to working on a sub-atmospheric cycle, which gives a low average density, and also the high velocities lead to small surface areas and a small number of stages in the compressor. The high gas speeds used should facilitate the rapid transmission of heat to the cooling medium.

One of the principal advantages of the system is that, apart from auxiliaries, the only moving parts are the turbine wheels and the gas, a simplicity it would be difficult to rival.

Operating on the Hepburn-Forbes system, the calculations, in which reasonable allowances have been made for losses, show that an overall efficiency approximating to that of the Diesel engine should be obtained, and there is therefore a wide margin for unforeseen contingencies between this value and the efficiency of the very best steam turbine.

Radio Telegraphy.

AN interesting lecture on "Radio telegraphy" was recently delivered by Senatore Marconi before a joint meeting of the American Institute of Radio Engineers and the New York Section of the Institute of Electrical Engineers, and is published in the August issue of the latter Institute's *Journal*. A very great impulse had, Mr. Marconi said, been given to radio telegraphy and telephony by the discovery and utilisation of the oscillating or electron tube or triode, which was the outcome of the observations and discoveries of Edison, Fleming, De Forest, Meissner, Langmuir, Armstrong, and Round. As regards the progress made by the Marconi Company, it had so far been desirable to use in long-distance stations a plurality of valves connected in parallel, and in that way it had been possible to supply 100 kilowatts to the antenna. At the present time his company was supplying valves having a capacity of 4 kilowatts, and the requisite number of those valves were connected in parallel.

At first some difficulty was experienced in working valves in that way, but it had been found that no trouble was experienced if groups of sixty valves were worked with 12,000 volts on the plate. He understood, in fact, that no insurmountable difficulty would be experienced if it were desired to supply 500 kilowatts to the antenna from a number of parallel connected valves. The life of the valves had been very materially increased, and the 4-kilowatt units were expected to last for well over 5000 hours. The development of single valves of considerable power was progressing favourably. His company had recently given attention to the development of high-power valves made of quartz, and two sizes of these valves were being made, one for supplying 25 kilowatts to the antenna and the other for supplying 75 kilowatts ; but it was not expected that the efficiency of those high-power valves would be as good as that of a number of smaller units, and the work on the large valves was only in the experimental stage. A large amount of investigation had been carried out during the last two years on the efficiency of transmitting circuits and with respect to the best way of utilising the available energy.

A considerable increase in the efficiency of aerial circuits had been obtained, and there had also been material progress in the direction of minimising the losses in the attendant loading coils, and the latest results indicated that it was possible to obtain an efficiency of radiation into space as high as 50 per cent. on wave lengths as long as 20,000 m. when using towers 250ft. high. Very careful investigations had been carried out by Mr. Round in connection with the losses in the loading coils and other parts of the valve circuits, and actual measurements, when using a considerable amount of power, had shown that it was possible to obtain an overall efficiency of 70 per cent. in relation to the input power on the plates and the aerial without giving rise to harmonics, the efficiency taken from the power input to the plates and the actual radiation into space being about 35 per cent. In the case of stations working with shorter wave lengths it was possible to increase the efficiency still more ; although possibly it would not be advisable to obtain this higher efficiency on account of the extra expense involved. One of the English stations, which was working on a 3000 m. wave length and which had 100 m. masts, showed an efficiency of 40 per cent. in respect of the energy supplied to the plates and that radiated into space.

Apart from the question of efficiency, a great amount of attention had been paid to the question of maintaining a constant frequency, and as the result of careful investigations it was now possible to secure a degree of constancy which left little to be desired. Simple and reliable methods of high-speed keying had been developed, and on the shorter waves it was possible to transmit 1200 words per minute, whilst on the longer waves the speed might be increased to whatever value the aerial constants would permit. Public services at Paris and Berne were working at a speed of 100 words per minute, and a single aerial transmitter with two wave lengths on the aerial was used. Although the practice of utilising a single aerial for two wave lengths was not advisable for high-speed power, it offered certain advantages for medium power work, for the consequent loss of efficiency could be made up by a slight increase of power. Both at Paris and Berne the two waves were working duplex and practically all the messages were dealt with by printing machinery, although there were occasions when undulator tape and telephones had to be resorted to. The reception at these relatively short-distance stations was done by means of a cascade arrangement of high and low frequency tuned amplifier circuits attached to the directional Bellini aerial, which, when necessary, was arranged for unidirectional reception. Great care was taken to shield the tuned circuits so as to ensure that they came well into action and to prevent any direct effect or influence of the aerial on circuits other than those which were intended to be acted upon. The characteristics of all those circuits had been very accurately measured so as to give filter curves suitable for the required working speeds, and all adjustments were easily made by the operators. No particularly sensational method of eliminating static troubles had so far been used.

The careful measurement and study of the constants of all circuits in use and the design of more efficient circuits based on the results of those measurements were being carried out systematically. As the result of those investigations several improvements had suggested themselves, and if appropriate means could be devised they would be applied in the future. Interference from other stations had, of course, increased enormously, and that had perhaps checked the increase of speed ; but, fortunately, the prevention of interference from other radio stations was a very much easier problem to deal with than that of the prevention of disturbances caused by natural electric waves or statics. Among the different types of tube amplifiers used in modern radio receiving stations the tuned high-frequency and audio-frequency amplifier probably excited the greatest technical interest. Its advantages were fully realised during the war, and at the time the Armistice was signed there were few radio laboratories in which time had not been spent in experimenting with that type of receiver. If the research work that had been carried out had not been quite successful as regards preparing or fixing the design of practical apparatus, it had indicated that the main difficulty to be overcome was that of combining considerable amplification with stability, and that the problem became more difficult with an increase in the number of tubes connected in cascade.

In 1920 an important step was, however, made by Mr. G. Mathieu in respect of solving the problem. The work related to the design of a new type of intervalve tuned transformer with an air core and constructed with an extremely small electrostatic capacity between the windings and having an effective primary impedance about equal to the effective plate to filament resistance in the valve when the secondary circuit was brought into a state of resonance with the frequency of the oscillations to be amplified. The results obtained during the first tests on these new transformers appeared to be quite amazing, the amplification of one tube having passed suddenly from 5 to about 15 for the particular tube tested, whilst the stability proved infinitely better than that which had been obtained previously, even when the grid of the valve was kept at a negative potential of one or two volts. The same principle had proved equally successful when applied to the design of iron core low-frequency transformers ; but in that case it was necessary to use an iron magnetic shunt between the windings so as to provide a sufficiently loose coupling between the primary and secondary circuits of the transformer. Recently Mr. Mathieu had still further improved the design of his high-frequency transformer by making it astatic.

It had been clearly realised by most radio workers for some years that the science of radio telegraphy had reached a stage of development at which mere guesswork had done nearly all that could be expected of it, and that the improvement and development of commercial telegraph services over what were once considered exceedingly long distances necessitated some very definite knowledge of the following points : —(1) The strength of signals that could be relied upon with given arrangements over those distances ; and (2) the all-important question of the ratio of the strength of signals to that of the natural disturbances and interferences acting on receiving stations in various parts of the world. First of all, suitable and reliable apparatus for the purpose of obtaining the necessary data on both these points had to be developed. Apparatus for giving the data was in systematic daily use in a good many far distant places, and a vast amount of valuable data was being collected. At those observation points the signals from distant stations were measured at all times of the day and night, also the strength of static interference and the direction or bearing from which static troubles emanated. Continuous wave signals equal to those received from the distant transmitting stations were induced in the aerial and the voltage

applied to the aerial was measured. An aerial of standard size was used for the purpose and the strength of the signals in microwatts per meter could be calculated. If the signals were unreadable owing to static interference the measuring apparatus was used to send signals to an operator at a standard rate of twenty words per minute and using a five-letter code, the voltage applied to the aerial from the local sender being increased until complete reliability was obtained. The ratio of the new voltage applied to the aerial to that of the old voltage gave a very correct estimate of how much the power at the transmitting end would have to be increased to ensure reliability. As the variation could be carried out on aerial systems giving direction diagrams, the method was obviously of great practical utility.

The question as to whether it would not be possible to transmit radio signals right round the world as far as the Antipodes was one which had always fascinated him. The results recently obtained, and which went to show the relative facility with which radio signals could now be sent from England to Australia, seemed to indicate that there was something in the idea of wireless waves travelling round the earth by various ways and re-uniting at places near the Antipodes. Still more interesting and precise data had been obtained during other and more recent tests. During expeditions to Brazil and New Zealand a number of most interesting and instructive observations had been made, and although complete reports had not been received, some of the most important tests were of considerable interest. Mr. H. H. Beverage, of the Radio Corporation of America; Mr. N. W. Rust, of the Marconi Company; and Mr. Eichkoff and Dr. Esau, of the Gesellschaft für Drahtlose Telegraphie, of Berlin, had just completed a series of observations at various points on the Atlantic Coast of South America, where the intensity of the signals from European and other stations had been observed and measured at all times of the day and night, and where the direction and intensity of atmospherics or statics had been observed and recorded over considerable periods of time.

Another expedition under the direction of Mr. E. Tremellen, of the English Marconi Company, had just completed its work of measuring signals from all European and American high-power stations on a journey between England and New Zealand *viâ* the Panama Canal, and from the mass of information gathered appertaining to both day and night signals it should be possible, among other things, to reconstruct the attenuation formula. Incidentally, the strength of the signals greatly exceeded that which might be expected from the results given by the Austin-Cohen formula.

Complete measurements from England had been made on the Carnarvon, Nauen, Bordeau and Hanover signals, whilst in Brazil measurements had been made on the American high-power stations and on the United States naval station P.N.O., at Cavite, in the Philippine Islands. During the expeditions to Brazil and New Zealand the fact had been noted definitely and independently that signals from stations at very great distances do not always retain their direction along one great circle, but reach the receiver from either way or various ways around the earth. Those important observations were made by means of loop aerial direction finders arranged so as to give the well-known heart-shaped diagram, and the very interesting fact had been recorded independently by those that took part in both expeditions that on many occasions during the transition period, *i.e.*, when the wave is changing from one way round the earth to another way, the two or more sets of waves produce, when received on a simple vertical aerial, fairly slow beats resembling Morse signals. Those beats were caused by mutual interference or the addition of the two sets of waves, whereas on the heart-shaped direction finder arrangement the signals were quite steady and normal when it was turned so as to receive only from one way or the other.

The observers noted that the American signals coming from the Radio Central and from Tuckerton preferred to travel a distance of three-quarters of the way round the earth rather than come the shortest way round. On other occasions the observers noted that at or near the Antipodes the direction finder indicated that signals from the English or German stations were often coming from all directions. At Rocky Point, New Zealand, Mr. Tremellen noted that signals from Nauen appeared to travel to him *viâ* the South Pole, whilst those from Hanover, which is not very far from Nauen, appeared to prefer to travel *viâ* the North Pole. A much more complete and exhaustive series of tests was being made at fixed stations in Australia so as to obtain, if possible, all the variations from one period of the year to another. It seemed to have been definitely ascertained that the sources of bad atmospheric disturbances or statics were situated chiefly overland, but observations in Brazil had indicated that a type of static known as a "grinder" originated a long way off and in a direction of the African coast, and at a time of day when static interference at that locality would be at a maximum, whereas a very violent click type of static came from a direction which indicated that its source was nearly in South America.

During his own journey across the Atlantic static interference appeared to be coming mainly from the European and African continents, but at more than halfway across they came from westerly directions, *i.e.*, from the American continent. Similar changes in the direction of origin of those disturbances had also been noted under similar conditions by Mr. Tremellen whilst crossing the Pacific. Another fact which could be fairly well deduced from those tests over very great distances was that transmission from west to east was apparently easier than from east to west. A scientific paper giving the results of measurements and of observations made during the two expeditions would shortly be published.

In 1919 short wave experiments were commenced by Mr. Franklin at Carnarvon. Electron tubes or valves were used to generate the short waves, and the object was to evolve a directional radio telephonic system. By means of those valves a 15 m. wave could easily be generated. After overcoming a few practical difficulties strong and clear speech was received at Holyhead, 20 miles away. Longer distance tests were next undertaken and a receiving set was installed in one of the mail boats running between England and Ireland. During those tests clear speech was received all the way over to the Irish coast into Kingston Harbour, at a distance of 78 miles from Carnarvon. As a result of the success of those experiments it was decided to carry out further tests over land across a distance of 97 miles between Hendon and Birmingham, and it was proved at once that with reflectors at both ends good and clear speech could be exchanged at all times between those places. The power supplied to the tubes for that transmission was usually 700 watts. The aerial was rather longer than half a wave length and had a radiation resistance which was exceedingly high. The efficiency taken between the power supplied to the tubes and the aerial power was between 50 and 60 per cent., and about 300 watts were actually radiated into space. With the reflectors in use at both ends speech was strong and of very good quality. With a ¼ ohm to ½ ohm shunt across the 60 ohm telephone speech was just audible. Measurements made by Mr. Franklin indicated that the value of the energy received when both reflectors were in use was about 200 times that of the energy received without any reflectors.

Experiments carried out with revolving reflectors, which make it easy to read measurements at any distance, proved that the polar diagram for a given reflector and wave length is practically constant at all ranges. By means of suitable electron tubes or valves it was now possible to produce waves from about 12 m. and upwards when utilising a power of several kilowatts, and it was also practicable to utilise valves working in parallel. During the continuous wave tests at Carnarvon it was found possible to receive messages on the aerial whilst the transmitter was operating, and the system was being used successfully for duplexing between Hendon and Birmingham. Besides giving directional working and economising power, reflectors practically eliminated speech distortion. The results obtained between Hendon and Birmingham constituted a record for radio telephony so far as the ratio of distance to wave length was concerned, as Birmingham was 10,400 wave lengths from Hendon. Those experiments had shown for the first time that electric waves of the order of 15 m. to 20 m. in length were capable of providing a good and reliable point to point directional service over quite considerable ranges.

The results obtained with reflectors appeared to be so good that he was tempted to try his old idea of twenty-six years ago and test the system as a position finder for ships near dangerous points. Through the courtesy of Messrs. D. and C. Stevenson and the Commissioners of Northern Lights, trials of that kind were being undertaken in Scotland. The trials were being carried out under the supervision of Mr. Franklin with a revolving reflector erected at Inchkeith Island, in the Firth of Forth, near Edinburgh. The revolving transmitter and reflector acted as a kind of wireless lighthouse or beacon, and by means of the revolving beam of electric radiation it was possible for ships, when within a certain distance, to ascertain in foggy weather the bearing and position of the lighthouse. The experimental revolving reflector was erected during the autumn of 1920, and experiments were carried out with the ss. Pharos. With a 4 m. spark transmitter, a reflector and a single-tube receiver suitably tuned on the ship, a working range of 7 miles was obtained. The reflector was caused to make a complete revolution every two minutes and a distinctive signal was set at every half point of the compass. It was ascertained that this enabled the bearing of the transmitter to be accurately determined within a quarter point of the compass, or within 2.8 deg. At a later date a new reflector was designed, and it was now being tested. The attenuation of short waves over the sea was so regular that a little experience enables distance to be judged by means of a potentiometer.

As was first shown by Hertz, electric waves could be completely reflected by conducting bodies. In tests which he—Mr. Marconi—had conducted he had noticed the effects of reflection and deflection by metallic objects miles away, and it seemed to be possible to design apparatus which would enable a ship to radiate or project a divergent beam of rays in any desired direction, and on coming across another metallic object, such as a ship, the rays would be reflected to a receiver screened from the local transmitter on the receiving ship and thereby immediately reveal the presence and bearing of other ships in fog or other unfavourable weather. The advantage of the scheme would be that it would give warning of the presence and bearing of ships that were not provided with any kind of wireless apparatus.

Industrial Electric Heating.

THE position with regard to industrial electric heating, and particularly electric furnaces in which the heat is generated by passing a current through a metallic resistance, is dealt with in an interesting article by Mr. J. G. Pearce in the July issue of the *Metropolitan-Vickers Electrical Gazette*. Electric heating, the author explains, has been made possible by the development of a group of alloys of nickel and chromium, but many technical difficulties surround the mixing and working of these alloys, and their manufacture has only been commenced in this country during the last few years. The alloys are usually made in ¼in. rods, and four months must elapse before the strip and wire which are usually employed for heating purposes is in its final form. Many trade names have been applied to these alloys, but, as a matter of fact, there are only a few varieties.

The principal properties of these alloys are:—(1) Ability to withstand high temperatures; (2) ability to resist acid; (3) good heat conduction and high specific heat; and (4) very slight oxidisation. Any resistance required is obtained with a comparatively short length of wire, and the current does not vary appreciably with the temperature. In order to cheapen production, the alloy usually contains iron in the percentage of 30 per cent., this being quite suitable for temperatures up to, say, 800 deg. Cent. The alloy can be cast in sand, and a tensile strength up to 40 tons has been reached. The wire resistance is so easily applied to a furnace that users sometimes wind their own furnaces with the aid of data supplied by the manufacturers.

Electricity, the author contends, is the ideal heating agent. It can be used at any point where heat is required, and the system is very flexible. Moreover, every unit of heat purchased can be converted into heat, and practically the whole of this heat can be utilised for the purpose for which it is required. In other words, electrical heat can be efficiently applied and efficiently conserved. The thermal efficiency of an ordinary furnace, it is explained, decreases with increasing temperature, owing, first of all, to the greater volume of air which has to be heated, and in which a greater quantity of heat is lost, and partly to increased radiation losses. In the electrical furnace the former loss is wholly eliminated, whilst by effective lagging, the latter loss can be brought down to a value which cannot be approached by any other kind of furnace. Various other advantages of the electric furnace are also given, such, for instance, as the possibility of accurately measuring and regulating the temperature.

There are now, the author states, innumerable examples of use of electricity for heating at fairly low temperatures. Electric furnaces are used for enamelling, baking cores and for many other workshop processes. The construction of these ovens or furnaces is very simple, and the furnaces are practically standardised as regards size, shape and rating. For enamelling the parts of typewriters, continuous conveyor ovens are used, the dipped work being hung on a conveyor which passes through the oven. Similar ovens are now widely employed in the motor car industry for drying the dipped bodies, &c. Ovens used for drying foundry cores are claimed to give more uniform heat than coke-fired or gas-fired ovens.

In the latest type of resistance furnace used in America the resistor is actually placed inside the furnace, so that it radiates heat directly to the material. A small muffle furnace of this type made by the Westinghouse Company consumes 6.8 kilowatts and attains a temperature of 2000 deg. Fah. in 75 min. The temperature can be controlled in fifty steps between the limits of 500 deg. and 2000 deg. Fah. During the war great strides were made in America in connection with the use of these wire-wound furnaces for the heat treatment of gun forgings. In these large furnaces sections of nichrome ribbon, measuring 2in. wide by ¼in. thick, are used, and they are supported by refractory insulating members projecting from refractory furnace walls, which may be 4in. thick and covered with 9in. of heat insulation. In the case of one installation there were four furnaces and a quenching tank, each furnace being 24ft. high and 6ft. in diameter, and rated at 400 kilowatts at 440 volts, at a periodicity of 60 cycles. It was found on one occasion that the heating of seven 4in. tubes weighing 22,300 lb. took 1880 kilowatt-hours, and three 4in. water jackets weighing 21,700 lb. 2088 kilowatt-hours. With current at 1d. per unit, the operating cost would be about 17s. per ton, but the actual cost in America was 12s. per ton. The time taken to heat was 5½ to 6 hours, the steel being hardened at 1450 deg. Fah. and tempered at 1150 deg. The radiation loss was 70 kilowatts. Twenty-two of these furnaces, with an aggregate capacity of 70,000 kilowatts, were built during the war, the largest being rated at 700 kilowatts. The total rating of these furnaces, however, only represents half the total rating of the furnaces in use. A furnace is at present being constructed, which will be 10ft. 6in. in diameter and 105ft. high, and will be capable of dealing with 320,000 lb. of steel when consuming 2850 kilowatts.

Annular ring furnaces are used for carburising and annealing motor parts. A typical furnace, 19ft. in diameter and 7ft. high and consuming 170 kilowatts, will deal with a 3000 lb. charge composed of pieces weighing from 3 lb. to 180 lb., and when shut off at night will anneal the steel casings before the morning, when it gives a temperature of 1000 deg. Fah. Forty minutes after the current has been switched on again, the temperature is back at 1525 deg. Fah. for hardening. The advantages which these furnaces are claimed to possess are:—(1) No distortion on long parts; (2) temperature, time of heating and rate of heating are under absolute control; (3) scaling is eliminated and only a flash pickle is required

for annealing, instead of one lasting three or four hours; (4) the physical properties are more uniform than usual; (5) labour is halved; (6) no rejections are necessary as the result of faulty heat treatment; and (7) hardening is made mechanical.

Long Distance Operation of Railway Facing Points.

IT has been left to the Great Central Railway Company to work, on a steam-operated passenger-carrying railway, facing points, direct from the lever in the signal box, at a greater distance than the 300 or so yards that has hitherto been the limit. The same thing has, for the last eight or ten years, been done in the United States, but with the exception of the present case and that on the Ashington Colliery Company's line—which latter is not a railway open for public traffic, and was described in our issue of May 19th—it has not up till now been attempted in this country.

Such an arrangement is bound to lead to great economies and—which is of equal importance—to quicker movement of trains and of concentration of work. One direction in which economies are possible is that, as in the present case, a signal-box can be saved. In stations, goods yards and at junctions, one box will do the work of two or, perhaps, three and two will do the work of three. Another sphere for economy is that the sidings—usually called refuge sidings—into which trains are shunted for more important trains to pass can be entered direct by facing points instead of the train having to be brought past the siding points and backed in. It is under the latter head that quicker movement of trains will be secured as a train will run into a loop and clear the main line in about three minutes, as compared with perhaps fifteen or twenty minutes for a shunting movement. The concentration of the work at a station into one box is so obviously an advantage that comment on that point is needless. Further, loops at passing places on single lines can be lengthened, which will admit of longer goods trains being run. It will also allow for ground frames at such places to be dispensed with and for all the work to be controlled from one box. Had this been the case at Abermule, the disaster there, eighteen months ago, might not have happened, as the porter who went off to the ground frame there was the man who operated

FIG. 1—JUNCTION FOR LEICESTER AND VERNEY JUNCTION, NEAR QUAINTON ROAD

there be a clear track up to a distance of 440 yards past the inner home signal 16, also that neither can be lowered if a train has over-run the opposing junction signal, *e.g.*, 13 is locked if a train has over-run 15 and got on to the E.F. track circuit. The circuits J.K. ensure that 43 shall go to "danger" as soon as the train it was lowered for has passed beyond the facing point, and

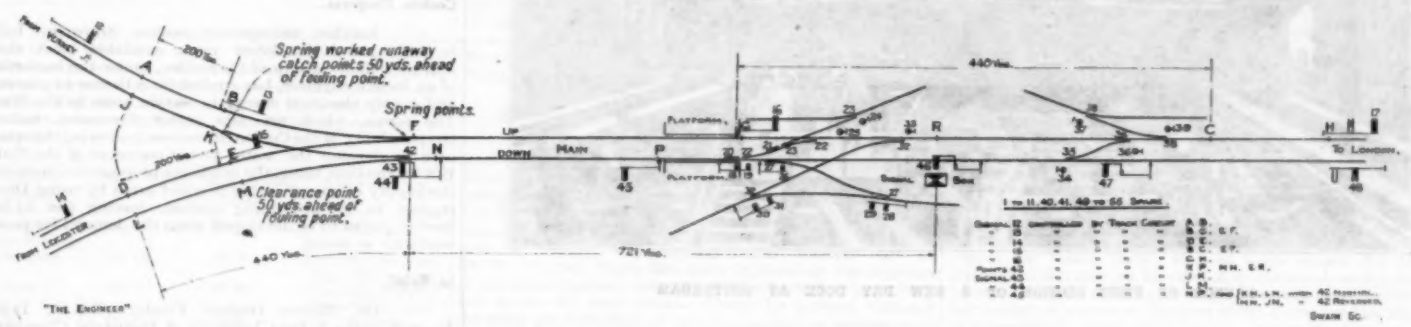


FIG. 2—ARRANGEMENT OF SIGNALS AND POINTS AT QUAINTON ROAD JUNCTION

the instrument to allow a tablet for the express to be withdrawn.

The scene of the present installation is Quainton-road, on the Metropolitan and Great Central Joint Railway, and about 6¼ miles north of Aylesbury. At this place, the line to Leicester leaves the original Metropolitan line to Verney Junction by a double line junction. This is seen in our illustration Fig. 1, which is a view looking south. The Leicester lines are in the right foreground, the Verney Junction lines on the left, while Quainton-road station is beyond the overbridge in the distance.

A signal-box used to work this junction but it has now been removed consequent on the facing points having been coupled to Quainton-road Station signal-box, which are situated at the south end of the down platform and 721 yards from the points. The signalling has been re-arranged, and is now as shown in Fig 2.

The security offered by track circuiting is very manifest in this case. The various controlls are shown on the diagram, and it will be noticed that, among others, neither of the up junction signals 13, 15 can be lowered unless

FIG. 3—MECHANISM FOR OPERATING THE FACING POINTS

to Verney Junction in the rear of the runaway catch points. If the points are reversed and lie for Verney Junction, the line must, by J.N. and N.P., be clear up to 440 yards past the junction and, by M.N., there must be nothing on the line to Leicester within 50 yards beyond the fouling point.

There is also track circuit control on 42 lever working the facing points. The presence of a train or vehicles between K. and P. will hold the lever at normal so that the points cannot be changed for a train to cross the junction, whilst M.N. holds it also and prevents the premature reversal of the lever, should 44 signal be restored after a train has passed on to the Leicester line. Yet more than this is done. In order to guard against the points being opened and made to lie for the Verney Junction direction whilst a train is running from Leicester, or some portion of it is standing foul of the junction, there is a track circuit from E. to opposite the signal-box at R.

The facing points, also signals 12, 13, 14, 15, 43, and 44 are operated electrically. The points of the trailing junction are left loose—being trailing there is no objection to this—and controlled by a spring so that they lie normally for the branch line.

Power for operating the facing points is obtained from a 24-volt accumulator battery of 40 ampère-hours capacity and, for operating the signals, from an 8-volt accumulator battery of 40 ampère-hours capacity. These batteries are in duplicate, so that one set may be sent away for recharging which is done every two months. For lever locks, indicators, track circuit control relays, &c., 12-volt accumulator batteries of 60 ampère-hours capacity are used. The accumulators, relays, &c., are situated in a special hut on the up side of the line, on the left in Fig. 1.

The mechanism of the facing points—Fig. 3—is the General Railway Signal Company's low voltage switch and lock movement which, along with other of that company's specialities, was supplied by the British Power Railway Signal Company, Limited, 3a, Dean's-yard, S.W. 1. It is shown with the cover removed, whilst the cover over the facing lock has been drawn aside. The initial movement actuates the rocker shaft and withdraws the plunger, the switches are then moved to their new positions and the final movement shoots the plunger again. The points are detected in each position, and the plunger when "home" by signals 43, 44, 45.

A circuit closer on No. 42 lever, provided the track circuits concerned are clear, causes the control relay in the battery house to be energised and for current to be switched on to the points. About 20 volts is required for operation, and the time taken is 18 seconds.

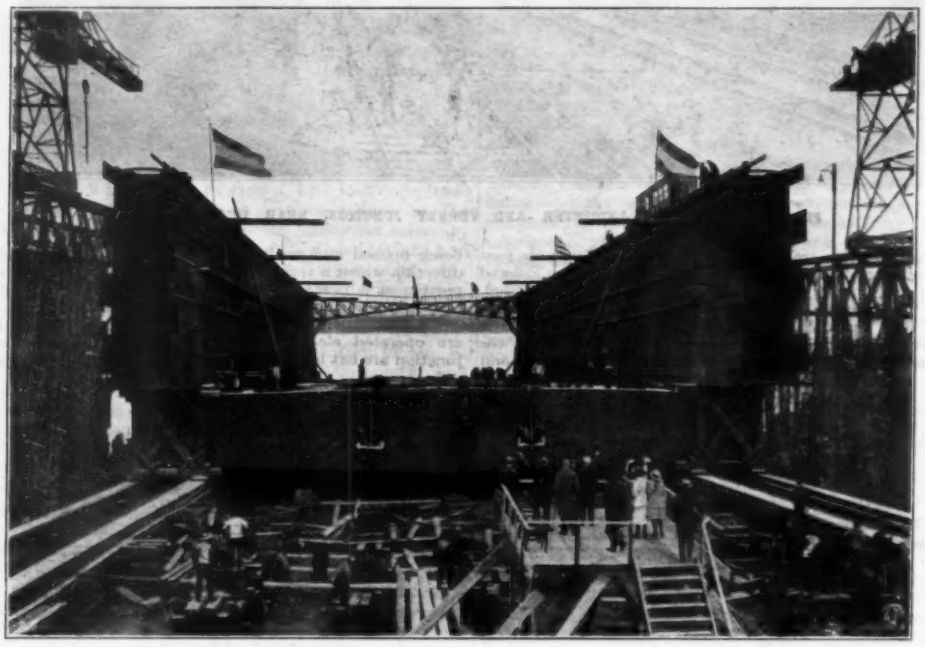
The signals are actuated by the General Railway Signal Company's low voltage mechanism fixed at the bottom of the post. Circuit closers on the respective levers cause current to pass through the track circuit relays concerned to the control relays which, in turn, allow the operating current at 8 volts to go to the mechanism. A signal is lowered in 5 seconds, and the holding off current is 0.008 amps.

We are grateful to Mr. Harry Blundell, the chief engineer, Great Central Railway, also to Mr. A. F. Bound, the signal superintendent, for an opportunity to visit and describe this work.

THE Iron and Steel Encouragement Bill has been passed by the Senate in South Africa. It appears that the bounty will amount to 15s. per ton, on an output of 50,000 tons per annum, and will be gradually reduced to nothing by 1931–32.

A New Floating Dry Dock.

AN interesting operation took place recently at the shipbuilding yard of the Rotterdamsche Droogdok-Maatschappij, when the first section—comprising four pontoons—of its new 15,000-ton floating dry dock was successfully launched. The illustration we reproduce shows the dock leaving the slipways and about to enter the water. The dock, when completed, will consist of seven pontoons having a total length of 575ft. and a breadth of 110ft., and its capacity will enable ships having a weight of 15,000 tons and a draught of 26ft. to be docked. In view of the extreme breadth of the dock, four parallel launching ways were built and special precautions were taken to prevent side movement. The initial start was given by four hydraulic rams. All the auxiliary machinery for the dock is electrically driven, and a central control room is provided from which the dock is worked, special instruments recording the draught, bending, and the heel of the dock at any given moment. Large electric capstans are installed for drawing a vessel into the dock, and when in dock the ship is supported on fourteen mechanical shores. The capacity of the main pumps is such that even with the largest ships the dock



LAUNCH OF FIRST SECTION OF A NEW DRY DOCK AT ROTTERDAM

may be pumped dry within one and a-half hours after docking. For convenience of operation, all valves are opened and closed by means of compressed air. The fire extinguishing apparatus is very complete and the fire pump has a delivery capacity of about 400 tons of water per hour. The overhead crane service consists of two travelling cranes of 5 and 10 tons lifting capacity respectively. Various auxiliary engine rooms are built in the sidewalls of the dock and serve to provide accommodation for the 110 and 220-volt lighting and power service and also the compressed air plant. In order that steam may be supplied for heating or for operating the ships' machinery, a special line of steam piping is provided. Now that the first section of the dock has been launched, the keel for the remaining section of three pontoons is being laid down, and meanwhile the company's harbour is being prepared for the reception of the dock by dredging locally to a depth of about 56ft. The necessary connecting pipes, landing stages, and bridges are well in hand. The Rotterdam Dry Dock Company already owns two private floating docks of 330ft. and 440ft. respectively, and the new dock will form a valuable addition to its repair service equipment.

IMPROVING THE CITY OF BUENOS AIRES.

THE Municipal Council of the City of Buenos Aires is considering the flotation of a loan of 70,000,000 paper pesos (approximately £6,000,000) for the carrying out of an extensive scheme of improvements and public works. It is proposed to continue the widening of several of the main traffic arteries of the city, a badly needed improvement, and funds will be required for the compulsory purchase of land abutting on the congested thoroughfares. A start was made to widen the streets, and construct new diagonals through the heart of Buenos Aires, at the time of the Centennary of Independence in 1910, and those who remember the old city, with its narrow Spanish lanes, and pavements 3ft. wide, can speak of the vast improvement that has resulted.

From figures supplied by the city officials, it does not appear that the remodelling of the streets will be so very costly. The sum to be spent for the purchase of land will be approximately 50,000,000 dollars, but a great part of this will be recovered by the re-sale of frontages after the streets have been widened. The case is cited of the re-purchase of land in three of the principal thoroughfares at a cost of 3,962,332 dollars, and the re-sale yielding only 256,662 dollars less than this sum. In the Calle Corrientes, one of the main streets to be widened, land is valued at £6 per square foot.

Among the municipal works provided for are rubbish incinerators, stables for the Department of Health, a new boulevard along the river, and a city hall, the latter to cost 6,000,000 dollars, paper.

Argentine Oil Fields.

PUNGENT criticism of the Argentine Government's management of the oilfields at Comodoro Rivadavia has followed the demand, made in the Chamber of Deputies recently, for answers to a number of questions, designed to show that State control was both costly and fatal to free production.

The Argentine Government owns and operates a considerable extent of oil land at Comodoro Rivadavia, and also has wells at Plaza Huincul and elsewhere. Enormous sums of money have been spent in developing these properties under a special commission charged with the administration of the exceedingly valuable lands, and the gravamen of the criticism is that instead of the industry representing a valuable national asset, it is actually through mismanagement and political influence, a costly burden on the State. One of the questions asked in the Chamber of Deputies, was whether the former management had definite instructions from the Government to restrict production.

Figures for the first six months of 1921 and 1922 show the following as the output of the Comodoro Rivadavia field :—

	Barrels.	
	1922.	1921.
First quarter ..	448,600	531,000
April	201,800	140,900
May	157,500	138,400
June	205,100	139,000
	1,013,000	949,300

The excuse given for the limited production in 1921 was that means of transportation and storage facilities were not available. Since then, however, more tank steamers and reservoirs have been put into service without any correspondingly substantial increase in production, though private companies in the same district have doubled and trebled their output. One of the deputies who brought charges of maladministration of the enterprise stated that though 120,000 tons of oil were produced in 1916, at a cost of 3,180,000 dollars, the production of 208,000 tons in 1920, cost over 7,000,000 dollars, or, in other words, the cost rose from 26 to 33 dollars per ton. It is expected that a strong demand will be made by Congress for a thorough investigation of the State industry.

A decision of the Government, which will have an important bearing on the future of the private oil concerns operating in the Comodoro Rivadavia field, provided for the expenditure of 8,000,000 pesos in the construction of a port at the place mentioned. Preliminary work is to be started immediately with the dredging of a canal accessible to shallow craft. Subsequently a breakwater will be built, and behind this a basin and dock will be provided at which deep-sea vessels can moor to load or discharge. As Comodoro Rivadavia is at present, there is nothing but an open roadstead, exposed to gales which frequently make it impossible to discharge plant and material for days at a time.

THE Queensland Government has passed a Bill providing for the establishment of State steel and iron works at Bowen. Contemporaneously the State Government secured the hematite deposits of Yampi Sound, where there are large quantities of ore above high water. The ore is reported to contain less than 0.05 per cent. phosphorus. The proposition is that ships shall load the ore, transport it to the State coalfields at Bowen, and take back coal to Java *en route* for Yampi.

Indian Engineering Notes.

(From our own Correspondent.)

BOMBAY, August 12th, 1922.

THE Indo-European Telegraph Company's announcement that it intends to reopen the overland telegraph route to India, has been received in this country with interest. The lines between India and Mesopotamia were utilised to advantage during the war, but the European section suffered. It is hoped that with the repairing of this section and the establishment of through communication a reduction will be made in the cable fees, for at present the Indo-European Company is existing on finances obtained as a result of the Cis-Indian Joint Purse, an agreement entered into by the Eastern, Eastern and South African and Indo-European Cable Companies and the Indo-European Department to pool profits and divide them by an agreed formula. Although it is likely to be some time yet before the lines in Russia are repaired, the re-opening of the route is eagerly anticipated.

Railway Electrification.

Engineering schemes in India are born and ruthlessly put to death with surprising regularity, and the electrification of railways is one of these. Recently it was announced that the Great Indian Peninsula and Bombay Baroda and Central India Railways had schemes under consideration for the electrification of their suburban lines. Since then, however, the scheme has only been considered, and as yet no definite announcement as to when this desirable transformation is to take place has been made. That it will ultimately materialise, there appears to be no doubt.

In the meantime, the State of Mysore has also decided to consider a scheme for the electrification of its railways, making a beginning on the lines from Bangalore to Nanjangud. At present the scheme is only in its infancy, and the chief electrical engineer is engaged in collecting data so as to convert it into a practical proposition. The progress that has been made in Mysore recently in connection with the fostering of established industries and the foundation of new ones, leads one to believe that Mysore will have its electrified railways sooner than Bombay !

Cochin Progress.

Another enterprising native State in India is Cochin, and the latest news available from there indicates that a group of Cochinites, under the leadership of an Indian engineer, has applied for a license to generate and supply electrical energy in certain areas in the State. The terms, which are now under discussion, include the possibility of the Cochin Government allowing the syndicate to develop the water power resources of the State. But for the time being, the syndicate proposes to commence the supply of energy in the licensed areas by using Diesel engines in its generating station, leaving the hydro-electric power to be developed when the demand for power warrants so doing.

In Brief.

Dr. Martin Onslow Forster, F.R.S., D Sc., director of the Salters Institute of Industrial Chemistry, has been appointed director of the Indian Institute of Science, Bangalore, and will take up his duties with the New Year.

Sewage farms have recently been established at Mysore and Lucknow, and although only in the nature of an experiment, considerable success is said to have been achieved.

The Railway Board has sanctioned an estimate amounting to Rs. 685,413 for providing certain additional plants and machinery for the loco. shops at Parel and Jhansi. Sanction has also been accorded to estimates amounting to Rs. 2,438,898 for replacing fourteen passenger engines (W-1 and A-3 types) by fourteen 4-6-0 D4 type engines, and Rs. 2,801,270 for providing sixteen additional passenger tender engines 4-6-0 D4 type, during 1922-23.

The Department of Industries, Bengal, has opened a demonstration farm for tanning, at Comila.

French Trials of Suction Gas Vehicles.

As our Paris correspondent announced in his French Engineering Notes, published in our issue of August 18th, the outstanding event of the recent trials of suction gas vehicles, held in France, was the gaining of the first position in the classification by the sole British lorry represented. The 3-ton lorry, built by John I. Thornycroft and Co., Limited, at its Basingstoke works, which was awarded the highest marks and which it is admitted is built on sounder principles than the four vehicles entered by French competitors, has already been described in THE ENGINEER of July 7th, but it is now possible to give some further particulars regarding the trials and the results which were obtained.

THE OBJECT OF THE TRIALS.

The trials were organised by the French Department of Scientific and Industrial Research, and of Inventions in co-operation with the Ministry of Public Education, and a special technical commission, appointed by the French Automobile Club, with a view to ascertaining what saving of fuel might be effected by the application of suction gas for the propulsion of vehicles on road or rail, and for boats and agricultural tractors. It was also desired to know what were the different forms of apparatus which might be included in this category. The trials under consideration were specially drawn up for three and a-half ton motor lorries, and limiting conditions were imposed which determined the class of engine and the design of the producer. Thus it was laid down

that particular attention had to be paid to the producer and its scrubber with regard to its portability; moreover, the amount of water consumed in the producer and used for gas cooling was not to exceed one and a-half times the weight of the fuel consumed. The engine had to be a standard petrol engine of the type generally used for a three and a-half ton motor lorry, and could be chosen by the manufacturer whose vehicle was entered for competition, but no alteration to the design was permitted other than the replacement of the carburetter by a suitable gas and air mixing chamber, increased compression, and a wider ignition adjustment. The fuels allowed included all mineral fuels, also wood and charcoal, and the costs were computed in francs, the price of fuel being fixed according to a list drawn up by the Committee.

NATURE AND DURATION OF TESTS.

The trial was composed of two tests, a bench test and a running test, and competitors were obliged to submit two complete sets of apparatus, one for each test. The bench test was carried out at the laboratory of the French Automobile Club, 80, Boulevard Bourdon, at Neuilly-sur-Seine, where the engine and gas producer underwent a brake test and marks were awarded for flexibility and reliability of running, economy in fuel consumption, and the purity of the gas generated. The second part of the trial consisted of a road test, run under practical conditions, marks being awarded for the lowest cost per useful kilometric ton carried, regularity of running, and the best arrangement of the apparatus, involving such considerations as neatness of design, handling facilities, and ease of access, as well as strength and simplicity of the parts.

TRIAL RESULTS.

The following firms entered vehicles for competition and all the engines had four cylinders:

Firm.	Type of vehicle.	Engine particulars.	
		Bore.	Stroke.
		mm.	mm.
J. I. Thornycroft & Co., Ltd.	Thornycroft	114.3	152.2
Société de Vierzon	Delaugère	100	140
	Scemia	125	140
Société Le Gaz Pauvre dans ses Application (G.P.A.)	Saurer	110	140
Maison Lion Hermite	Saurer	110	140
Maison Gazes	Brasier	100	150

The bench tests took place on the 26th and 27th of June, when trials were run under the following conditions. Two hours preliminary run, a quarter of an hour running light, a quarter of an hour at quarter load, an hour and a-half at half load, three hours at three-quarters load and three hours at full load. The following results were obtained:—

Type of vehicle.	H.P.	Fuel consumption in kilos.	Nature of fuel.
Thornycroft	34.3	59.25	Charcoal
Société Vierzon:			
Delaugère	15.45	46.4	One-fifth charcoal, four-fifths wood
Scemia	20.6	63.6	One-fifth charcoal, four-fifths wood
G.P.A.	16.2	41.9	Charcoal
Lion Hermite	15.8	42.3	Charcoal
Gazes	20.4	40.0	Charcoal

The road tests, which included two runs of 60 kiloms., were carried out on July 21st and 22nd, an average speed of 15.25 kiloms. per hour being maintained. These tests gave results as follows:—

Type of vehicle.	Gross weight carried in kilos.			No. of ton kiloms.		Fuel consumption in kilos.	
	1st day.	2nd day.	Empty	1st day.	2nd day.	1st day.	2nd day.
Thornycroft	7400	7429	4250	200	216	53.2	51
Société Vierzon							
Delaugère	7568	6886	3610	250	208	86	80
Scemia	8347	7977	4695	236	213	81	88
G.P.A.	7470	7476	3820	227	227	54	46
Lion Hermite	7650	7644	4093	215	220	56	51
Gazes	7944	7945	4422	219	219	54.5	46

A detailed official report is in course of preparation, but the Judges have announced the following classification of competing firms according to marks gained:—John I. Thornycroft and Co., Ltd., lorry, Société Industrielle de Vierzon Orleans, Delaugère, lorry, Maison Lion Hermite, Saurer, lorry, Société Industrielle de Vierzon, Scemia, lorry, Maison Gazes, Brasier, lorry. Owing to a slight accident which happened to the gas producer of the Saurer lorry, entered by the Société le Gaz Pauvre dans ses Application (G.P.A.), which obliged this vehicle to run the last kilom. on petrol, it was not possible for the judges to classify it in accordance with the rules of the trial in spite of the very excellent qualities which it showed in the results above given. The results of this first series of tests are highly encouraging, and further developments in the direction of fuel economy may be awaited.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—It is proposed to hold the associate membership examination in London and at other places, at home and abroad, towards the end of October, 1922. Entry forms and full particulars can be obtained from the secretary of the Institution, Savoy-place, Victoria Embankment London, W.C. 2.

CONTRACTS.—We are informed by T. Rowlands and Co., Limited, Sheffield, that Messrs. Renton and Fisher, of Hopetoun Works, Bathgate, Scotland, have purchased from Messrs. the Volta Manufacturing Company, Limited, Welland, Ontario, Canada, which Messrs. Rowlands represent in Great Britain, a 3-ton "Volta" electric furnace.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

The Pig Iron Situation.

IN the pig iron department there is at the present time a complete absence of forward buying. Nobody orders a ton more than is actually needed for requirements actually in view. The principle of speculation appears to be non-existent. The tonnage of the orders placed is consequently very small, and instructions are accompanied usually by pressure for early deliveries. At the same time the aggregate of the small quantities called for is sufficient to prevent the accumulation of stocks at Northampton furnaces, although Derbyshire is not quite so fortunate, and the increase of stocks there has led to a slight weakening of prices. Pig iron smelters have failed to get any advance to reimburse them for the increased price they are being called upon to pay for their coke. This is a significant indication of the weakness of the market, for only the smallest provision has been made by consumers against prospective requirements, and current production of raw material is, of course, on a very diminished scale. The market is unmoved by reports of heavy shipments of pig iron to America. Quotations are at just about the same level as they were a week ago, and business has made no nearer approach to animation. The foundries of the district are buying pig iron in small quantities for prompt requirements. There is the promise of some engineering projects being put in hand, and this inspires a better feeling. Immediate orders, however, would be very welcome. A few orders for forge material have been placed, absorbing certain stocks which have become rather troublesome in view of the prolonged quiet demand. The difficulties of smelters have been increased by the rise in coke values, which now applies to most districts. Users of Yorkshire coke have to pay 2s. 6d. per ton more, adding anything from 3s. to 4s. per ton to fuel costs. One or two firms were bold enough to make a *pro rata* increase in pig iron prices, but speedily abandoned the effort when they found that other firms had made no alteration. The addition of one large furnace to the number in action in Northamptonshire has considerably increased the competition. Owners of idle furnaces, as a rule, decline to make a start until further relief in railway rates is forthcoming. A quantity of Midland iron is finding its way into the Scotch market, Northampton continuing to derive a little benefit from occasional shipments to the North of England, where prices are slightly above the Northampton figures.

Steel Competition.

Competition has become very keen in the raw steel department. Hardly anything is heard of continental offers, the cut in British prices having effectively excluded foreign steel. Orders have been taken as low as £7 per ton for billets. The nominal quotation is £7 5s., though this represents a reduction on recent figures. One steel firm is credited with having taken finished bars at £8 17s. 6d., well below the price declared on the occasion of the recent general reduction. There are, however, very few orders for steel about. Until the autumn demand develops the full effect of the free market in sections will not be known. Producers in this district are not following the lead of Scotland and the North of England in cutting the prices. They express themselves as opposed to any reduction, and they still want £9 for angles and £9 10s. for ship plates. Their comparative isolation enables them to ignore the lower quotations of other districts, where the struggle for business has brought the f.o.b. quotation for angles to something like £8. Bedstead angles have declined from £9 10s. to £9 5s. Associated houses now quote £11 10s. for steel hoops. The big steel works are competing strongly for the orders for gas strip, bedstead angles, &c., which for some time past have been left largely to the re-rolling works. Some very good orders for cotton ties and baling hoops generally, particularly for India and Egypt, are in the market, and heavy business is looked for from Australia owing to the improving conditions in the wool trade. But the bulk of this business is going either to Lancashire or Barrow. The severe railway rates offer a continuous obstacle to the recovery of a trade which was formerly very important in South Staffordshire.

Galvanised Sheet Prices Advanced

Makers of galvanised sheets have further advanced their prices, and are now asking £16 10s. f.o.b. Liverpool for galvanised corrugateds of 24 W.G., representing a rise of about 5s. on the week. This is partly due to the effect of the re-established pool, but a firmer spelter market is also to some extent accountable. The makers of galvanised sheets, despite the protests of consumers who view the continuous rises with much displeasure, are making a strong effort to maintain their prices on a remunerative basis. Some success is being realised in the recovery of lost markets, orders giving special encouragement having lately been received from the Near East and from selling centres in the Mediterranean. The usual extras are being charged for lighter gauge sheets, quotations for 28 gauge reaching, in some cases, as much as £28 15s. to £28 17s. 6d.

Bar Iron Trade.

There is only a poor demand for Staffordshire marked bars and for the better quality of merchant bar iron; indeed, all the departments of the bar iron trade may be described as flat. Yet Staffordshire ironmasters appear to be getting their share of the orders for finished iron in the market. In competition they derive a little advantage from the slightly lower wage rate. The season's call for fencing bars has lasted well, and there are still some orders coming in. Prices rule at £10 to £10 2s. 6d. There has been a falling off in the demand for nut and bolt iron. The annual suspension of activities in the Darlaston and Wednesbury districts for the wakes has been extended on account of the dearth of orders. Bar mills still ask £9 17s. 6d. for iron of nut and bolt quality. They do not greatly fear Belgian competition in existing circumstances, even though offers of material at £8 15s. continue to be made. Good class merchant iron continues to command from £11 to £11 10s., and marked bars rule at £13 10s.

Wages in the Chain Trade.

The Chain Trade Board has given notice of a proposal to vary the minimum rates of wages in the hand-hammered chain trade for periods dependent upon the cost of living index figure. The proposal, which will materially affect many workers in this district, provides that the minimum rates of wages to operate for the period during which the cost of living index figure is less than 90 but more than 72, shall be approximately 15 per cent. below the rates at present operating, and that such lower rates shall be subject to an addition or reduction of 5 per cent. for each completed rise or fall of nine points in the index figure above or below 81.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

General Conditions.

THE markets for iron and metals are still in a waiting condition, and no particular developments seem yet to be in sight. The expectation of any serious change this autumn would seem to be passing away and people are beginning to realise that patience is the virtue which is most likely to be exercised for the next few months. The general state of Europe, from the industrial as well as the political point of view, remains about as bad as it well could be, and the continual demoralisation of the exchanges is bringing about a condition of things which makes international business more and more difficult. We shall soon be in a position in which business will have to be carried on by barter and without the aid of currency, and the process of adjusting ourselves to this condition is bound to be very painful.

Copper.

The effect of the collapse in European currencies is seen in the condition of the copper market, which was beginning to recover from depression a fortnight ago, but has now suffered a relapse. Really the circumstances surrounding the copper market are more favourable than they were. The reduction made in the immense quantities of scrap material left by the war has been so considerable that the surplus of old material is not more than can easily be dealt with; and at the same time considerable progress has been made in the disposal of the large reserves of American copper. The recent set-back of the market must be attributed almost entirely to the political and financial confusion in Europe. It is noticeable that in this country very little change in the prices for consumers' copper has taken place. Refined ingot copper did not respond to the upward movement in standard, and it has taken no notice of the subsequent downward movement; but buying of copper on the part of the consumer has been on a restricted scale, and it is obvious that the total consumption is comparatively small. There has been some increase in the purchase of rough copper for the purpose of making sulphate, but, of course, this industry cannot consume any very large quantity, and both the engineering and electrical industries are still rather inactive buyers of the metal. The official prices for manufactured copper and brass, tubes, sheets, &c., remain unchanged, and one hears nothing about the possibility of a release from fixed prices such as has already taken place in the steel trade. It would be interesting to see what drastic changes in the prices would occur if competition were renewed amongst the various producers of these materials. At present the "ring" appears to be a stable arrangement.

Tin.

The sharp fall in the price of tin which occurred on the final market day of last week appears to be associated with some development of weakness in the East. Whether this means that the Federated Malay States and Dutch Governments are tired of holding up the market remains to be seen; but eventually, of course, there must come a time when the tin in reserve will have to be placed on the market. There seems to be no probability that the world consumption of tin will expand greatly and become able to absorb much more than the present production of the metal; and so long as this equilibrium between production and consumption continues these Governments will be left to hold the stocks.

Lead and Spelter.

Both lead and spelter have been easier of late, but the latter is probably cheaper merely in sympathy with the former. There was a break of nearly £1 per ton in lead prices, and it seems probable that some reaction will follow, for the conditions are much the same as they have been, except that there is a chance of some extra supply from Mexico.

Pig Iron.

The markets in Manchester for pig iron remain quiet and almost without feature. One hears reports from other centres, and particularly from Cleveland, that business is better, but so far as one can understand this does not mean that the ironfounders in the district are doing more business or buying more pig iron, but that the Americans have been placing some orders. This leaves the market here quite cold, because it is certain that the American demand cannot last very long, and even if it should result in higher prices for Cleveland it will have no effect on the pig iron which the Manchester ironfounder is using, viz., Derbyshire No. 3. The price for this delivered

in Manchester is still 90s. per ton, and there seems no probability of a fall; but consumers do not buy in large quantities, as they have got out of the habit of doing this. Scotch iron is, of course, affected by the American demand, and is now much dearer here; in fact, so dear that the Manchester ironfounder is struggling against the necessity of buying it. Hematite pig, on the other hand, is relatively cheap, and can be bought, delivered in Manchester, at 104s. per ton.

Finished Material.

There are reports of cheaper sectional steel in other districts, and particularly in Scotland, where competition is exceptionally keen; but here there has been no change in the prices, and the lowest quotations are about £9 10s. per ton. The orders coming in are only as a rule for small lots, and, of course, the lowest competitive prices would not be quoted on these. The position on the Continent is about the same, but there are no offers of cheap continental material in this market. It is, however, announced that a tramway steel order in Scotland has been taken by America, and this may be a far more serious matter for the steel trade of the country than any continental competition.

Scrap.

Dealers in the scrap market are now doing very little, but the prices keep fairly steady. Of course, in steel scrap they are about as low as they can be; and wrought scrap also is much more likely to be dearer than cheaper; but there is still room for a fall in cast scrap, and the market for it seems weak, although the old prices are still quoted.

BARROW-IN-FURNESS, Thursday.

Hematite.

There is a better tone in the hematite iron trade, and the signs are all pointing to a steady improvement. With the steel works busier and taking more iron, and with an improved trade the stocks are coming down, and the time will soon arrive when it will be necessary to put in more furnaces. There is still an abundance of inquiries, but not all of them lead to business, and what business does accrue means small orders. It may be that customers have not much business on their books and this leads them to order for only immediate requirements, or it may mean that some are hoping for a further fall in prices. At present costs of production a further fall is not very likely, for some smelters admit that the present prices do not cover all costs. Both on home and continental account the trade shows signs of development, but it will be slow.

Iron Ore.

The iron ore trade is dull. The fact that not so many furnaces are in blast reflects on the local ore trade. Not a great quantity is sea-borne, nor likely to be for some time. The activity of the native ore trade depends upon the number of furnaces in blast in the district to a great extent, and until there is an increase the trade will be dull. The same remark applies to the foreign ore, which is being imported at present in limited quantities.

Steel.

The steel trade is, comparatively speaking, fairly bright still, for both rail mills in the district are engaged upon colonial orders, and a cargo left Barrow last week for Alexandria. The orders held will keep them going for a week or two, and fresh orders may be booked before then. Competition is keen, and prices do not leave much, if any, margin. The hoop works continue to turn out a fair quantity of material. Foundries are moderately engaged.

Shipbuilding and Engineering.

There is very little being done in the shipbuilding and engineering trades, but it is hoped before long to have better news. It does not pay to start the construction of a single vessel, for then the overhead charges fall on the one ship. Shortly there will be a better state of affairs. As the orders for the two battleships are expected to be given out in the autumn there is hope for more work for the engineering side.

SHEFFIELD.

(From our own Correspondent.)

A Puzzling Position.

THE local industrial situation is somewhat perplexing; on the one hand there are fairly general reports of slight improvement in trade, and the records of two reliable criteria of trade conditions—railway traffic and Chamber of Commerce "certificates of origin"—confirm this. But, on the other hand, the register of local unemployed, so far from supporting this more encouraging estimate, shows a slight increase for the last week, while for a month or more the total has remained in the neighbourhood of 40,000—probably a higher proportion to population than that of any other important industrial centre in the country. Taking first the indications of improvement, some of the heavy steel departments are undoubtedly better occupied, and orders in the rolling mills are slowly growing in volume. More billets are being bought and used than for several months past, and this must inevitably mean more work in the finished steel departments. The railway traffic returns showed that while for the first half of the year Sheffield sent away less manufactured articles than in the corresponding period of last year, the July and August figures will completely re-adjust the balance in favour of the present year. Then, as stated above, there is the evidence of the Secretary of the Sheffield Chamber of Commerce, who says that the certificates of origin granted to local manufacturers who are exporting goods were five times as many last month as in the corresponding month last year. These exports certainly do not consist either of the special and high-grade steels which are more distinctively the product of Sheffield, or, on the other hand, of engineers' tools and cutlery; in all these departments very little, if any, improvement being as yet noted. Cheap finished rails made from old rails purchased as scrap are said to be selling freely for export, and other cheaper grades of steel are in demand.

Better Prospects for Cutlery and Tools.

There is, however, a brighter prospect for the makers of cutlery and small tools as a result of the obvious decline in German competition in these lines. The prices of these foreign goods have now, in many cases, reached beyond those at which Sheffield can supply, and as stocks of the German goods which flooded the market last year become exhausted Sheffield makers should have no difficulty in recapturing this market. The trade in scissors, penknives, and razors is already showing some signs of recovery, and as soon as the engineering trades regain anything like normal conditions there is likely to be a big demand for small tools, and with its present resources Sheffield could soon meet any demand. In this connection it is interesting to note that the Sheffield Steel Products directors, whose very extensive works between Sheffield and Rotherham are equipped with the most modern plant for mass production of tools as well as cutlery, attribute, in their recent circular to their shareholders, their difficulties largely to the effects of the engineering strike, and the impossibility of putting into operation the company's very extensive steel plant. They report, however, that "the position as regards orders is steadily improving, particularly in the cutlery and plate sections, in which a very large increase has taken place, the orders already in hand in these sections being sufficient to ensure their running continuously for some months." Here, as in several other Sheffield works, stainless steel has provided the research departments with material for considerable investigation, for this speciality seems to have many eccentricities not yet thoroughly understood. At the Steel Products works a new process for the manufacture of stainless iron has been put into practical operation on a limited scale with success, and it is hoped that the company will reap substantial benefits from its use and from the sale of foreign rights. It is of interest to note that this company's scheme of reorganisation includes the addition to the directorate of Sir George C. Buchanan and Brig.-Gen. H. A. Young, both of whom have had considerable experience in ordnance manufacture.

Orders Gained—and Lost.

Sheffield is hoping to reap some of the advantages resulting to Vickers by their success in securing the contract for the supply of several turbines in connection with the hydro-electric scheme being undertaken by the New Zealand Government. The technical organisation, which Messrs. Vickers have instituted to deal with all hydro-electric matters—having studied many of the great Swiss undertakings—works in close collaboration with the electrical engineering staff of the Metropolitan-Vickers Electrical Company, Limited, much of the work of which is carried out at the Sheffield branch. This firm, it may be recalled, recently obtained all the orders for the 6000 kilovolt-ampère generators and the 100,000-volt switchgear for the Mangahao hydro-electric power station in New Zealand. No great bulk of work is, however, coming to Sheffield from Vickers' Barrow shipyard, though the situation there does not appear to be without hope, as there are prospects of important contracts coming from Peru in connection with the reconstruction and conversion to oil fuel of two cruisers, built by Vickers sixteen years ago. Vickers are hoping also to get a share of the work in connection with the British battleship contracts shortly to be placed. All this will mean a certain amount of activity for the Sheffield steel-making plant, rolling mills, forges, &c. A less satisfactory incident of the past week is the Glasgow Corporation's acceptance of an American offer of special tramway track work, at a price £3000 below that quoted by a Sheffield firm. There has, however, been a good deal of misunderstanding of the real facts of this order and the explanation of Sheffield's higher figure. The truth is, I understand, that Sheffield quoted for one kind of material and America for another kind.

American v. British Tram Tracks.

Sheffield makers are convinced of the great superiority of the all-manganese track, comprising expensive manganese steel castings. The Americans have a system whereby small pieces of manganese steel are inserted in those parts of the lay-out which have to bear the brunt of the hard wear, and for the remainder of the track use a topping of ordinary steel rails. Having regard to the quality and cost of the respective materials employed, the Sheffield tenders were low in comparison with the one accepted. Thus the Americans have got the order not because they can produce and sell steel cheaper than Sheffield in the latter's own country, but because the Glasgow tramway authorities are willing to install the cheaper form of trackwork. Sheffield makers adhere to the manganese steel rails because experience has proved these to be much more lasting and economical in the end, and Glasgow is exceptional in its preference for the cheaper system. Sheffield firms are supplying trackwork regularly to tramways all over the United Kingdom, and this week one firm, the Titan Trackwork Company, has despatched to Plymouth layouts to the value of nearly £7000.

Will Tramways Survive?

On the general question of tramways as an economical proposition in competition with petrol-propelled vehicles, it is significant to find that the Sheffield Corporation has curtailed a somewhat considerable programme of tramway extensions. Two, each of about half a mile, have recently been carried out partly with a view to providing employment, and another is about to be commenced, of about similar length. But a number of "linking up" schemes whereby various suburban routes would be joined and thus provide circular runs, have been deferred, if not abandoned, as it is considered desirable to adopt a waiting policy in view of the possibility of the tramway system of transport becoming obsolete within the next few years.

Fuels and Alloys.

The fuel position has not materially changed during the last week or two. There is perhaps rather more inquiry for industrial coals, but blast-furnace coke, both for home and American consumers, is much more in demand and the price has firmed, as much as 25s. having been paid per ton at ovens for shipment. The market for steel-making alloys generally continues flat, and in some cases the prices are easing a little. The current price of tungsten powder has, however, advanced from 1s. 8d. to 1s. 9½d. per lb., this being the second recent increase. The rise is not so much due to increased demand as to an advance in the cost of wolfram ore, consequent upon stocks running short. Ample supplies of ferro-chrome are coming from Scandinavia, and nickel is also offered freely. Continued slackness in the engineering trades keeps foundry pig very quiet, but scrap is selling freely, Germany being a ready buyer, almost regardless of price.

Colliery Developments.

No very considerable colliery developments are in contemplation at present in addition to those already announced, with the exception of the New Moncke-ton new pit, the sinking of which was postponed owing to the war, and is now to be resumed at an early date.

NORTH OF ENGLAND.

(From our own Correspondent.)

The Trade Outlook.

THERE is a growing confidence that the autumn months will see a marked revival in the industrial position in the North of England. At all events during the current week there has been increased activity in most of the markets, and the outlook is more encouraging than it has been for a long time past. The outstanding feature at the moment is the continued heavy demands from the United States for coal and iron, but the export trade is also expanding in other directions, which indicates that a better time is in store for industry generally.

Cleveland Iron Trade.

The position in the Cleveland pig iron trade is gradually improving. Many of the home foundries are now fairly busy and are contracting for pig iron supplies up to the end of October, and in some cases to the end of the year. There has also been some expansion in the Scottish demand, and as prices there have stiffened, Cleveland iron is now able to get in at slightly below the price of Scottish iron. The outstanding feature of the iron trade, however, is the continued strong demand from America. Large quantities of special Cleveland foundry iron have been sold, but United States buyers are not adhering so rigidly to the demand for iron of special analysis, and there has just been concluded a big contract for ordinary Cleveland foundry iron for shipment across the Atlantic. The result is that some of the makers have actually sold out all their stocks, and are unable to quote for the better qualities of Cleveland iron. Even the lower qualities are now being sought by American buyers, and further sales are expected. The consequence of this improved trade, though it is probably but a passing phase, has been the stiffening of prices, and although possibly 87s. might still be done, 87s. 6d. per ton is now the general quotation for No. 3 G.M.B., whilst No. 1 and siliceous iron are very firm at 95s. No. 4 foundry has been sold at 85s. per ton, but 86s. is the general figure; 84s. is asked for No. 4 forge, and 80s. for mottled and white.

Hematite Pig Iron.

Improvement is also recorded in the hematite pig iron trade. Makers have been doing better business lately and stocks are not so heavy. There have been fairly good shipments to Italy, and the home demand tends to expand, but not to such an extent as to warrant as yet the re-starting of any more furnaces. The price of mixed numbers ranges from 89s. to 90s. per ton, with No. 1 quality at 6d. premium.

Iron-making Materials.

The foreign ore trade is still very quiet and prices are inclined to droop. Freights are easier, but sellers cannot realise 24s. 6d. per ton for best Rubio ore, buyers holding off for lower figures. The foreign demand for coke is as strong as ever, and sellers of good medium furnace qualities firmly quote 27s. 6d. per ton delivered at the works. The fact is that everything that makers have to spare can be shipped abroad at higher figures, and all that makers are doing is to meet their contract obligations with the ironmasters.

Manufactured Iron and Steel.

The uncertainty regarding prices in the manufactured iron and steel trade still continues, and until it is removed business is likely to remain restricted. Still the works are better situated so far as orders are concerned, and when the market becomes more settled, the position will probably show a marked improvement. At the moment there is not only a wide variation between home and export prices, but also a wide difference in sellers' prices on the home market. Thus, whilst steel ship plates are quoted £9 per ton, and in some cases £9 10s., business is reported at £8 16s. 3d., whilst steel angles, quoted at £8 15s. to £9, have been sold at £8 11s. 3d. Steel joists are quoted £9, heavy steel rails £8 15s., steel boiler plates £12 10s., and galvanised corrugated sheets £16 10s. to £16 15s. per ton.

The Coal Trade.

The position in the Northern coal trade is still seriously affected by the continued congestion and dislocation at the docks and staiths. It is no rare thing

for steamers to wait from eight to ten days for a berth under the spouts. Thus the temporary expedient of a few hours' overtime is not meeting the situation, which, in the view of most of the large exporters, can only be met by the institution of a third shift of trimmers and teemers so as to ensure a constant and continuous loading at all the spouts. The American demand, both for the United States and Canada, has again developed; but as a rule there is a lack of stability about the trade which destroys anything like optimistic certitude, and causes operators to move cautiously, in view of the fact that when the position alters and conditions seem to move against the buyers, cancellation of orders very often follows, which means loss to the exporters on this side. The requirements of this trade are chiefly for prompt shipment, and as the supplies are somewhat limited, the actual bookings are restricted, though a number of spot deals have been put through, while in the case of Canada the demand is expected to hold good much longer than for the States. The continental inquiry keeps very quiet and intermittent. There is no apparent anxiety to purchase on the part of any of the usual European importers, operations being confined in every case to weekly or monthly parcels to meet current needs. There is, however, a merchant's inquiry in circulation for 30,000 to 40,000 tons of Durham coking coals for shipment to France, during October, November and December next. German inquiries are not up to what they were a little while ago, and business is fluctuating, though some preliminary inquiries for large quantities have been made recently and then withdrawn again for the present. The market values remain rigid and assured for all brands of best and second Northumberland screened steams, with smalls equally strong. The Durham market is patchy and uncertain in places, but the outlook is in some respects improving for secondary sorts of gas and coking. There is good inquiry for all classes of coke, especially for foundry qualities, and prices all round are steady.

SCOTLAND.

(From our own Correspondent.)

Exports Growing.

OVERSEAS markets are showing more activity, and inquiries for all classes and descriptions of materials are steadily growing. Local makers are making every possible provision and concession to foreign traders, and their efforts are now meeting with some reward. There is a growing confidence in the various trades that the tide has at least partially turned, and if home demands would show more life, the outlook would be promising.

Shipbuilding Orders.

The announcement of contracts for the building of five new ships on the Clyde is very welcome news. For a long time back this industry has been in a most discouraging position. Many empty berths have characterised almost every yard in the district, and the lack of new business was phenomenal. As ships were launched, berths became vacant and lay in that condition for months, and in some cases, for a year or two. At the week-end, an unofficial conference of shipbuilders, shipowners, and trade unions was held, and although nothing of a definite nature has been announced, the meeting is said to have been wholly satisfactory and likely to bear fruit in the near future. If such is the case, it will be a most happy result and one with a far-reaching effect on all the allied industries in the area. Other similar conferences may be held.

Glasgow Buys American Rails.

Considerable comment, mostly of an adverse nature, has been caused through the action of the Glasgow Corporation in buying tramway rails from America when there is so much unemployment in the steel trade at home. The American tender was £15,335, while British firms quoted £18,262, £18,549, and £18,624. It is argued that the amount saved would have been better spent at home fostering local trade, especially at a time when large sums of money are swallowed up by unemployment benefits.

Pig Iron Slower.

The home market for pig iron has been slower during the past week, and perhaps the firming in price may be partly responsible for this. Foundry qualities are doing comparatively well in the matter of export orders. Inquiries from America have been fairly prominent, though there is a lull in this direction meantime. Hematite meets with little business and remains firm at about £5 7s. 6d. per ton.

Steel and Iron.

So far as regards the home market, caution in buying is the keynote. Fuels may have a downward tendency, but they have a considerable distance to travel before consumers' ideas are satisfied. Local requirements remain small, and nothing beyond them is being contracted for. It is said that local shipments have been sold at £8 16s. 3d. for ½in. upwards and angles at £8 11s. 3d. per ton for home use. Export is improving. Steel sheets have met with good orders for the lighter gauges for shipment, and heavy gauges also show some movement. Bar iron is a shade better both in home and export directions. Home prices are firm, but concessions are obtainable for a good export specification. A fairly steady turnover in re-rolled steel bars is reported. Any recovery in scrap materials is very slow. Supplies are not too plentiful, however, and prices remain firm. Semi-finished material of continental manufacture is finding its way into local markets, but the turnover is not large meantime.

Coal.

The export branch of the Scotch coal trade remains firm in all directions. The volume of business in round coal is unsteady, but the collieries have considerable orders still on hand. Inquiries continue to be received from America despite the settlement of the strike there, while orders are expected from Canada. Prices are still maintained, though a tendency to ease slightly was noticeable towards the end of last week. There is no diminution in the demand for washed materials, and many orders are in hand for shipment to Scandinavia and Germany in particular. East of Scotland ports are especially busy. Many steamers are in port and considerable congestion is reported. Long delays are unavoidable, and difficulty is experienced in fixing cargoes. Prices are very firm. Aggregate shipments for the past week amounted to 369,522 tons, against 364,340 in the preceding week and 341,311 tons in the same week in 1913. The home trade is extremely slow; even for urgent requirements buyers are reluctant to pay the current prices and, therefore, are absolutely determined not anticipate supplies.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The American and Canadian Demand.

THERE has been no special feature during the past week as regards the American and Canadian operations in supplies of coal from this district. Business has been proceeding on quiet lines and there has been no rush of orders, but up to the present, tonnage has been chartered to lift about one and a-quarter of a million tons of steam and anthracite coals. Most coalowners and exporters here are convinced that considerable quantities will yet have to be arranged for shipment during the next few months, and this opinion is supported by the views of Mr. H. H. Merrett, one of the directors of the firm of Messrs. Llewellyn, Merrett and Price, of Cardiff, who is now in America. In his opinion, the railway strike in America dominates the position, and although the bituminous miners have resumed work a serious shortage of wagons is and will be experienced. The shopmen's strike on the railways has played havoc with the condition of the rolling stock, yards being full up with wagons needing repair. Even if the coal and railway strikes were settled at once, it is his view that no colliery would receive more than about 50 per cent. of its usual supply of trucks for some time. In Mr. Merrett's opinion, the railway strike looks like a fight to the finish, and both sides are preparing on this basis. Stocks of anthracite coal are nil, and before very long the coal position, both in America and Canada, will reach a crisis, and the probability is that the demand for imported coal will increase. In the case of Canada, the prospects of getting more than a temporary foothold in this market are regarded as very hopeful, and Mr. Merrett states that the Canadians would welcome them with open arms, and once South Wales proves that Welsh coal can be put into their ports at prices near to those for American coal the trade will come this way.

Ebbw Vale Miners.

Since writing last week, the situation at Ebbw Vale has considerably improved, and instead of the whole of the miners at the Ebbw Vale Company's collieries being out on strike they are back at work. In order to get their grievances remedied, the men's advisory agent had organised "dignified demonstrations" to be made at the various collieries, winding up with a mass assembly on the Saturday at the Ebbw Vale offices, but on Friday, representatives of allied unions intervened as mediators, and the result was that on Saturday the leaders of the miners had an interview with the directors of the Ebbw Vale Company and Mr. Evan Davies, the men's advisory agent, put before the board the position from his point of view, but without discussion. It was made a preliminary condition of this interview that the by-product men were instructed to continue work and the colliers at the Marine and Waunllwyd pits to return to work at the usual time on Monday. After Mr. Davies had addressed the board, the directors informed him that if he would place a specific list of any matters requiring attention before Mr. Frank P. Hann, the general manager, at his earliest convenience, they would be dealt with, and in the event of failure to agree between himself and the manager, all matters left undetermined should be referred to the proper authorities and follow the usual procedure. The position is, therefore, that the men's leaders are now going back to constitutional methods for the settlement of their grievances.

Colliery Developments.

On Monday last, the cutting of the first sod of the new Steer pit of the Gwaun-cae-Gurwen Colliery Company, Limited, took place, the ceremony being performed by Mr. Edward Steer, the chairman of Guest Keen and Nettlefolds, Limited, with which undertaking the Gwaun-cae-Gurwen Company is now associated. It was stated that the new pit, which would be 350 yards in depth, would work the Big Vein, the Peacock Vein, and the Middle and Lower Veins of the anthracite series producing coal of exceptionally high quality. It will be the first of a number of new pits the Gwaun-cae-Gurwen Company intends sinking in connection with the development of its extensive mineral area. About 1000 men will eventually be employed in this new undertaking. Progress is also reported with the new colliery at Blaina, owned by the Ebbw Vale Company. This new colliery has been named the Beynon colliery, after Sir John Beynon. The shaft and buildings are in course of construction and hopes are entertained that within a few months coal will be within reach, thus giving work for some of the unemployed. The Company intends erecting by-product and washery plant near the colliery, which will be worked by electricty.

Transport Workers' Ban.

As far as can be seen, a very interesting position is likely to arise as the result of the Transport Workers' Federation's ban on the loading of the steamer Emanuele Accame, which is manned by a Fascisti crew, and was due to arrive at Cardiff on Tuesday. According to the secretary of the Federation, this steamer has been taken over by the Fascisti as an act of piracy, contrary to the wishes of the Italian Government, the Italian employers and the Italian workpeople, but it is evident that there is some misapprehension about the whole matter, as the Italian consul at Cardiff says that everything is in order, and he has been asked to facilitate the loading of the ship. This steamer has been chartered to lift a cargo of coal for the United States and carries a cargo of about 10,000 tons. Arrangements are being made for the coals to be ready for shipment, and the Great Western Railway Company has obligations placed upon it by Act of Parliament. The Company cannot refuse to admit the steamer to the docks, and it must ask its employees to load the steamer, and in the event of their refusal the question of their dismissal may arise. Some important questions may arise, including that of whether the owners of the steamer have a claim for damages in the event of the vessel not being loaded.

Current Business.

Generally speaking, the steam coal market keeps very steady, and, as far as the superior coals are concerned, they are pretty fully booked up for the next few weeks, and owners are proceeding very cautiously as regards quoting for shipment ahead in case the demands from America and Canada should become more extensive. The majority of the collieries are indicating round about 30s. for best Admiralty large for delivery the second half of September, but are not in a position to consider any earlier shipment. Superior small coals are rather scarce and quotations range about 22s. to 23s. The continental demand for coals continues rather quiet, but it is expected that before very long some of the consumers in France and Italy will be running short of stock, and will be coming along for supplies. Anthracite coals are very firm, and, in fact, are relatively stronger than steam coals. Best anthracite large is quoted at 60s., while machine-made cobbles and nuts range from 72s. 6d. to 75s. It is extremely difficult to get supplies for anything like prompt loading.

Swansea Metal Exchange.

The tin-plate trade continues quiet with prices steady on the basis of 19s. 1½d. to 19s. 3d. for prompt supplies, though business has been done at the lower figure for October delivery. Export operations are on a limited scale, though bookings on Canadian account are expected before very long.

Ebbw Vale Fitters.

Trouble has now arisen at Ebbw Vale affecting fitters, boilermakers and blacksmiths employed by the Ebbw Vale Company. About 200 men have ceased work, the cause of the trouble being alleged to be the introduction of a new card system. Unless the stoppage is brought to an end at an early date there is the possibility of the steel works having to close.

EXPERIMENTS made at the Eiffel Tower station are reported to have shown that the efficiency of the musical spark transmission is 47 per cent. and that of the Poulsen arc system 29 per cent. If, however, the Poulsen arc is employed with no compensating wave, its efficiency rises to 45 per cent. At the station of La Doua, near Lyons, experiments were made in order to establish the cost of transmission with the Poulsen arc and with the high frequency alternator. The latter apparatus appears to be much more economical than the former, the alternator requiring only about 54 per cent. of the energy required by the arc. The care required by both types of apparatus, the accidents in their working, and the sundry expenses have been minutely analysed, and the result appears to be favourable to the use of the high-frequency alternator.

Two engineers, Messrs. Eckstein and Corner, belonging to the Marconi Company, whose services were requisitioned by the Government of India, have now practically completed the automatic telephone exchange installation at Coonoor with the exception of the engine and batteries which are shortly expected from Calcutta. According to the *Indian Eastern Engineer*, the engineers having arrived in Madras in March commenced the work of installation about the middle of April. The installation on the Nilgiris is the well-known relay automatic telephone exchange, patented by the Marconi Company. This type of the installation is specially adapted for a moderate size exchange comprising from 100 to 500 lines. After finishing their work at Coonoor the engineers will move to Ootacamund to commence the installation there, which is expected to occupy them for the next two or three months.

THE following work has still to be put in hand in connection with the Vaal River scheme, according to the *South African Mining and Engineering Journal*:—River pumping station: Guides and screens, cast iron pipe specials, power transmission line from main station to river pumping station. Main pumping station, Vereeniging: Foundations for turbo pumps and alternators, station piping (suction and delivery), station water supply, coal conveyor plant, station lighting. Staff quarters, Vereeniging: One pair semi-detached cottages. Precipitation and filter plant: Sludge pumps and motors, sludge well and building filter house and offices, lighting, chorination plant. Reservoirs: Collecting reservoir in connection with filters and concrete work for filters. Laying-out grounds: Storm-water drainage and sludge pipe line. Pipe line: 24in. by-pass at the village main reef pumping station. Extensions at Zwartkopjes: Coal conveyor plant and alterations to flues. Transmission lines and instruments: This matter is under discussion with the Irrigation Department and the Water Court, and the work will be carried out as soon as a definite understanding is arrived at. The plans and specifications for the whole of the above work are well advanced and will be ready before the pipe lines are completed. It is estimated that the construction work will be finished about the end of April, 1923.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	22/6
(1) Spanish	22/6
(1) N. African	22/6
N.E. COAST—	
Native	—
Foreign (c.i.f.)	24/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	5 7 6	—
No. 1 Foundry	5 0 0	—
No. 3 Foundry	4 15 0	—
N.E. COAST—		
Hematite Mixed Nos.	4 9 0	4 9 0
No. 1	4 9 6	4 9 6
Cleveland—		
No. 1	4 15 0	4 15 0
Silicious Iron	4 15 0	4 15 0
No. 3 G.M.B.	4 7 6	4 7 6
No. 4 Foundry	4 6 0	4 6 0
No. 4 Forge	4 4 0	4 4 0
Mottled	4 0 0	4 0 0
White	4 0 0	4 0 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
Part Mine Forge	*None offering.*	
(3) Northampton—		
Foundry Nos. 2 and 1	*Nominal.*	
,, No. 3	4 0 0	—
,, Forge	3 10 0 to 3 12 6	
(3) Derbyshire—		
No. 3 Foundry	4 1 6 to 4 2 6	
Forge	3 12 6 to 3 15 0	
(3) Lincolnshire—		
Basic	4 0 0 to 4 5 0	
Foundry	4 5 0 to 4 10 0	
Forge	4 2 6 to 4 5 0	
(4) N.W. COAST—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	5 5 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 10 0	10 10 0
Best ,,	12 0 0	—
N.E. COAST—		
Crown Bars	11 0 0	—
Tees	10 10 0	—
LANCS.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	13 15 0
S. YORKS.—		
Crown Bars	12 0 0	—
Best ,,	13 0 0	—
Hoops	14 0 0	—
MIDLANDS—		
Crown Bars	11 0 0	—
Marked Bars (Staffs.)	13 10 0	—
Nut and Bolt Bars	9 15 0 to 10 0 0	
Gas Tube Strip	11 0 0 to 11 5 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	12 10 0	—
Ship Plates ¼in. and up	9 0 0	—
Sections	8 15 0	—
Steel Sheets ⅛in. to ¼in.	10 5 0	—
Sheets (Gal. Cor. 24 B.G.)	—	17 12 6

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 16 3 to 9 0 0	—
Angles	8 11 3 to 8 15 0	—
Boiler Plates	12 10 0	—
Joists	9 0 0	—
Heavy Rails	8 15 0	—
Fish-plates	13 10 0	—
Channels	13 10 0	—
Hard Billets	8 15 0	—
Soft Billets	7 15 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 10 0	—
Light ,,	11 0 0 to 13 0 0	
Billets	9 5 0	—
Ship Plates	10 0 0	—
Boiler ,,	13 10 0	—
MANCHESTER—		
Bars (Round)	9 0 0 to 9 10 0	
,, (others)	9 10 0 to 10 0 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	9 0 0 to 10 0 0	
,, (Lancs. Boiler)	13 10 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Bessemer Billets	12 10 0	—
Hard Basic	8 15 0	—
Soft ,,	7 10 0	—
Hoops	12 5 0	—
Soft Wire Rods	10 0 0	—
MIDLANDS—		
Small Rolled Bars	9 5 0 to 9 10 0	
Billets and Sheet-bars	7 2 6 to 7 5 0	
Gas Tube Strip	10 0 0 to 10 5 0	
Sheets (20 W.G.)	11 5 0 to 11 10 0	
Galv. Sheets (f.o.b. L'pool)	16 5 0 to 16 10 0	
Angles	9 0 0 to 9 10 0	
Joists	9 0 0 to 9 10 0	
Tees	10 0 0	—
Bridge and Tank Plates	9 0 0 to 9 10 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/1½ to 19/3
Block Tin (cash)	159 10 0
,, (three months)	159 15 0
Copper (cash)	62 10 0
,, (three months)	62 15 0
Spanish Lead (cash)	24 0 0
,, (three months)	23 7 6
Spelter (cash)	30 17 6
,, (three months)	30 7 6
MANCHESTER—	
Copper, Best Selected Ingots	67 10 0
,, Electrolytic	69 10 0
,, Strong Sheets	94 0 0
,, Loco Tubes	0 1 1½
Brass Loco Tubes	0 0 11½
,, Condenser	0 1 2½
Lead, English	25 10 0
,, Foreign	24 5 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit
Tungsten Metal Powder	1/9½ per lb.	
Ferro Tungsten	1/6 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24	10/-
,, 6 p.c. to 8 p.c. ,,	£23 10 0	9/-
,, 8 p.c. to 10 p.c. ,,	£23 10 0	8/-
,, Specially Refined		
Max. 2 p.c. carbon	£60	26/-
,, 1 p.c. ,,	£70	30/-
,, 0·75 p.c. carbon	£75	37 -
,, carbon free	1/7 per lb.	
Metallic Chromium	5/- per lb.	
Ferro Manganese (per ton)	£15 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£12 10 0 scale unit	5/- per
,, ,, 75 p.c.	23 10 0 scale unit	6/- per
,, Vanadium	18/- per lb.	
,, Molybdenum	6/- per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£160	
Cobalt	11/- per lb.	
Aluminium (per ton)	£82 to £100 (British Official.)	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	22/6
,, ,, Ell	23/6
,, ,, Splint	24/- to 26/-
,, ,, Trebles	23/-
,, ,, Doubles	22/-
,, ,, Singles	21/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	22/6
,, ,, Splint	24/-
,, ,, Trebles	23/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	22,6 to 25/-
Screened Navigation	30/-
Trebles	23/6
Doubles	23/-
Singles	21/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	23/-
Secondary Steam	22/-
Trebles	23/6
Doubles	22/6
Singles	21/6

ENGLAND.

(8) N.W. COAST—	
Steams	30/-
Household	46/8 to 57/6
Coke	33/-
NORTHUMBERLAND—	
Best Steams	25/- to 26/-
Second Steams	23/- to 24/-
Steam Smalls	17/6 to 20/6
Unscreened	20/6
Household	25/- to 28/-
DURHAM—	
Best Gas	24/- to 25/-
Second	21/6 to 23/6
Household	25/- to 28/-
Foundry Coke	33/- to 35/-

SHEFFIELD—	Inland.	Export.
S. Yorks. Best Steam Hards	21/- to 22/-	—
Derbyshire Hards	19/- to 20/-	—
Seconds	18/- to 20/-	—
Cobbles	17/- to 19/-	—
Nuts	15/- to 16/-	—
Washed Smalls	10/- to 11/-	—
Best Hard Slacks	12/- to 13/-	—
Seconds ,,	9/- to 10/6	—
Soft Nutty ,,	7/6 to 8/6	—
Pea ,,	7/- to 8/-	—
Small ,,	2/- to 4/6	—
House, Branch	30/- to 33/-	—
,, Best Silkstone	27/6 to 29/-	—
Blast Furnace Coke (Inland and Export)	20/- to 23/-	

(9) SOUTH WALES.

CARDIFF— Steam Coals:	
Best Smokeless Large	30/6 to 31/6
Second ,, ,,	29/6 to 30/6
Best Dry Large	30/- to 31/-
Ordinary Dry Large	29/- to 30/-
Best Black Vein Large	29/- to 30/-
Western Valley ,,	28/6 to 29/6
Best Eastern Valley Large	27/6 to 28/6
Ordinary ,, ,,	25/- to 27/6
Best Steam Smalls	21/6 to 22/6
Ordinary ,,	20/- to 21/-
Washed Nuts	30/- to 35/-
No. 3 Rhondda Large	30/- to 31/-
,, ,, Smalls	22/- to 23/-
No. 2 ,, Large	24/- to 26/-
,, ,, Through	21/- to 23/-
,, ,, Smalls	16/- to 17/6
Coke (export)	40/- to 45/-
Patent Fuel	27/6 to 30/-
Pitwood (ex ship)	32/6 to 33/-
SWANSEA— Anthracite Coals:	
Best Big Vein Large	62/6 to 65/-
Seconds	55/- to 60/-
Red Vein	52/6 to 55/-
Machine-made Cobbles	72/6 to 75/-
Nuts	72/6 to 75/-
Beans	45/- to 50/-
Peas	24/- to 25/-
Breaker Duff	8/6 to 9/-
Rubbly Culm	15/- to 15/6
Steam Coals:	
Large	27/- to 27/6
Seconds	24/- to 25/-
Smalls	14/6 to 16/-
Cargo Through	19/6 to 22/6

(1) Delivered. (2) Not Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b for export. (9) Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

Trade Improvement.

AT this time of the year, when the holidays are drawing to a close, the trade curve usually tends to move upwards, and although the movement is not pronounced it is, nevertheless, strengthened by the distribution of contracts for steam machinery, railway, bridge, and other work. Some of the big firms are now assured of employment during the winter. It cannot be said, however, that the improvement is general, and if the present distribution of contracts should be followed by a quiet period the curve will move down again, for the business done is only just sufficient to keep the majority of the works running. The future depends upon the amount of money what will be available for carrying out the various public works, and the fact of there being so much work ahead helps to sustain confidence, which is not even affected by the further depreciation of the franc, that being entirely overshadowed by the sensational collapse of the mark. Some people go so far as to suggest that French trade will benefit from the German disaster, in the sense that the reported closing down of German works through the inability of manufacturers to obtain credit and purchase what they require from abroad will relieve the pressure of German competition and may result in foreign orders, which would otherwise go to Germany, being diverted to other countries. It is, nevertheless to be feared that the German collapse will have a serious effect even upon French trade by suppressing the heavy purchases of raw material and produce which Germany has been making for many months past.

Engineering Strike.

While the outlook appears more satisfactory so far as the volume of work is concerned, it is being greatly darkened by the labour troubles which are becoming increasingly serious. More than two months ago the operatives in the engineering trades in the Havre district came out on strike against a 10 per cent. reduction in wages. As the competition in shipbuilding and repairs has become very keen, the engineering firms, which are nearly all engaged more or less upon this work, declared that they could not continue operations unless the men agreed to a reduction in wages. After standing out for so long a time, a large number of men desired to return to work, and this alarmed the union, which came out in its true colours and has been openly carrying on a communist agitation. For the time being, the union was able to count upon the tolerant attitude of the socialist municipal council until the Government intervened and took measures to ensure that order was maintained. Offers of arbitration have been refused by the employers, who declare that they have come to the end of their sacrifices and that rather than lose money by paying the old wages they will keep the works closed. In defence of a principle that employers shall not be allowed to reduce wages the strike has extended to all the other trade corporations of Havre, including the dockers, who have paralysed the whole district. The pronounced revolutionary character of the strike is causing some uneasiness. Trouble is also feared in the Nord and the Pas de Calais where there is to be a conference between the miners and coalowners over the question of the eight hours day, and as the colliers declare that they will not give in on this matter under any circumstances, the only hope of a settlement lies in the men giving a guarantee of a minimum output. The early introduction of a Bill for modifying the application of the eight hours to the marine is also preparing the way for a struggle which, it is feared, will be of a particularly severe character.

Hydraulic Works.

The proposal of M. Le Trocqueur to compel the Germans to supply men and material for carrying out the hydraulic works in France at their own expense does not seem likely to meet with any more success than the other attempts to secure reparation from Germany. The first part of the programme has at least been approved by the Reparations Commission. It consists in the execution of hydraulic works on the Rhone, Truyère and Dordogne, the construction of the tunnel for the proposed line between St. Maurice and Wesserling and the construction of the North-East Canal for connecting up the Saar, Moselle, Meuse and Scheldt. The total cost is estimated at 4824 million francs. In view of recent developments it is difficult to say how and when the scheme will be presented to Germany, but it is certain that the Germans themselves regard this method of reparation with considerable disfavour. They affirm that they are quite prepared to carry out reconstruction work in the devastated area, but they refuse, they say, to build pyramids for the victors.

Foreign Trade.

On account of the difficulty of estimating the value of the foreign business when based upon different methods of valuation, the only sure comparison is the weight of goods imported and exported. During the first seven months of the year the imports amounted to 28,667,342 tons, an increase of 8,714,946 tons, as compared with the similar period of 1921, while the exports totalled 11,713,758 tons, an augmentation of 2,448,164 tons. In both cases the increases were due almost entirely to raw material. While the imports of manufactured goods amounted to 969,874 tons the exports rose to 1,287,887 tons. In both cases there was an improvement. According to the declared values for import, manufactured goods, although showing a small increase in tonnage, declined in value by 908 million francs, but on account of the heavier importations of raw material and foodstuffs there was a net total increase of 588 million francs. In the case of exports, which were estimated by the official scale established in 1921, there was a heavy reduction in values all round. Although the weight of manufactured goods exported increased by 106,450 tons, the value declined by 347 million francs and the total declension amounted to 751 million francs.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

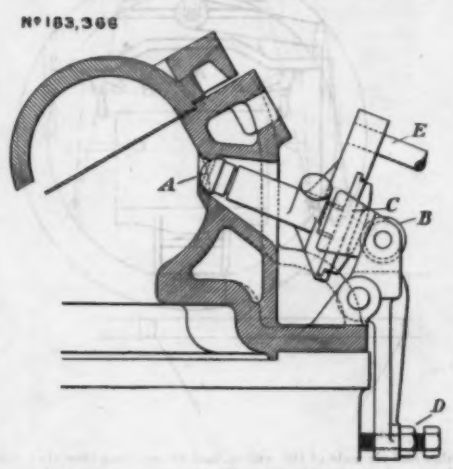
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

183,366. August 10th, 1921.—FUEL INJECTION DEVICES, E. Gardner, Barton Hall Engine Works, Patricroft.

This fuel injector is capable of adjustment so that the direction of the jet of fuel may be varied to suit the load on the engine. For full load the jet is directed right across the combustion space, and for light loads it is pointed up into the top of the dome, where it will be surrounded with a comparatively small mass of

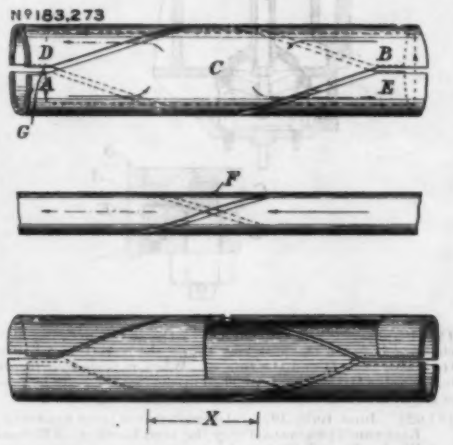


air. The end of the jet has a hemispherical seating A and is held up to its seating by the roller B bearing against the arc-shaped block C. The roller is pressed against the block by the lever and screw D. The fuel is supplied to the jet through a flexible pipe, while a handle E is provided for adjusting the angle of the jet. Alternative methods of clamping the jet are illustrated.—*July 27th*, 1922.

DYNAMOS AND MOTORS.

183,273. April 28th, 1921.—IMPROVEMENTS IN OR RELATING TO CONDUCTORS FOR ELECTRIC MACHINES, The Brush Electrical Engineering Company, Limited, of Falcon Works, Loughborough.

The object of this invention is to avoid eddy currents being set up in the conductors of turbo-alternators and other electrical machines. A and B are two lengths of conductor having a U-shaped cross section and united by a bent or joggled portion C, D, E and F being the corresponding parts of the companion conductor. The continuous dotted line in the upper drawing represents the path which would probably be followed by eddy currents in a single solid conductor, and assuming the sense of the current to be indicated by the arrow heads on the dotted

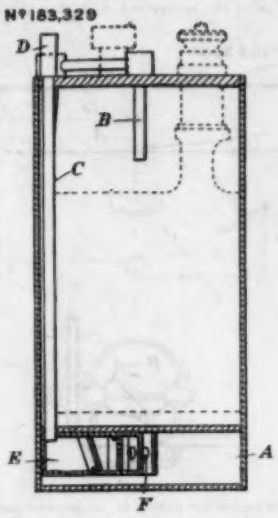


line, then it will be clear from the full-line arrows that the eddy currents in the top and bottom conductor A and B will tend to move towards each other to the portion C, whilst the eddy currents in the top and bottom of the conductor D and E will tend to move away from each other. G is the gap for the insulation between the straight portions of the conductor. If air be circulated from end to end of the conductor the latter may be enveloped externally by an insulating covering, but if the machine be provided with a central duct, then the external covering may be omitted between, say, the limits marked X.—*July 27th*, 1922.

BATTERIES AND ACCUMULATORS.

183,329. June 13th, 1921.—IMPROVEMENTS IN ELECTRIC STORAGE BATTERIES OR ACCUMULATORS, Henry Moss Genese and Pete and Redford, Victoria Works, Ashstead, Surrey.

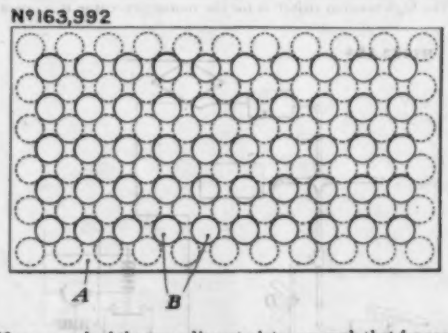
The object of the improved accumulator described in this specification is to prevent the escape of solution when cells are inverted or when they are being charged. At the bottom of the accumulator there is a small trap chamber A, whilst at the top there is a vent tube B, which terminates above the level of the acid, so that when the cell is inverted the acid will not overflow into the open end of the tube. This vent tube B is connected at the top of the cell to a tube C, which terminates in the trap chamber A. There is also an outlet D for carrying away the gases. Within the trap chamber A the tube C is connected to a baffle chamber E, which contains baffle plates which prevent



the liquid entering the open end of the tube D. The baffle chamber E is placed in communication with the chamber A by a small perforated tube F.—*July 27th*, 1922.

163,992. May 25th, 1921.—ELECTRICAL ACCUMULATORS, Gustave Philippart, of 17, Rue de Valois, Paris.

The insulating plates A, which are used as separators, are perforated with a large number of orifices in such manner that the total section of the orifices is an appreciable fraction of the total surface of the plate. The respective arrangements of the

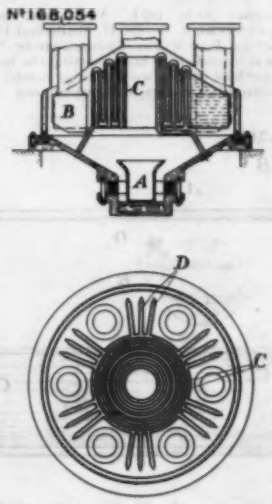


orifices on each of the two adjacent plates are such that for each orifice on one plate there is a corresponding solid part of the other and *vice versa*. The intervals separating the orifices are just sufficient to cover the corresponding orifices B of the adjacent plate or plates.—*July 27th*, 1922.

TRANSFORMERS AND CONVERTERS.

168,054. August 10th, 1920.—IMPROVED APPARATUS FOR CONDENSING THE MERCURY VAPOUR IN METAL VAPOUR RECTIFIERS, Siemens-Schuckertwerke Gesellschaft mit beschränkter Haftung, of Siemenstadt, near Berlin.

The cathode of the rectifier is shown at A and the anodes at B. The condensing apparatus consists of a number of double-walled cylinders C, which are traversed by a cooling liquid. Cooling



pockets are also provided as shown at D. The mercury vapour is condensed at the upper part of the apparatus, and the liquid mercury flows back into the cathode vessel without in any way interfering with the electrical process.—*July 27th*, 1922.

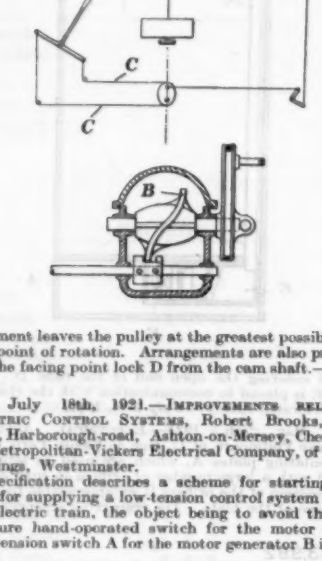
TRAMWAYS AND RAILWAYS.

183,326. June 10th, 1921.—OPERATING RAILWAY POINTS, S. T. Dutton, 83, York-road, King's Cross, London, N. 1; and the Westinghouse Brake and Saxby Signal Company, Limited, 82, York-road, King's Cross.

Although we have had some difficulty in fully comprehending this specification, it appears that the claim is made for a mechanism which provides a more forcible control of the points at the commencement of their movement than is the case with the usual type of switchgear. To this end the normal stretcher

bar A is engaged by a scroll-shaped cam B, which is rotated by wires C C from the signal cabin. These wires are attached to an elliptical pulley on the cam shaft in such a manner that they are tangential to the major diameter of the ellipse at the commencement of the movement, and that the wire effecting

No 183,326

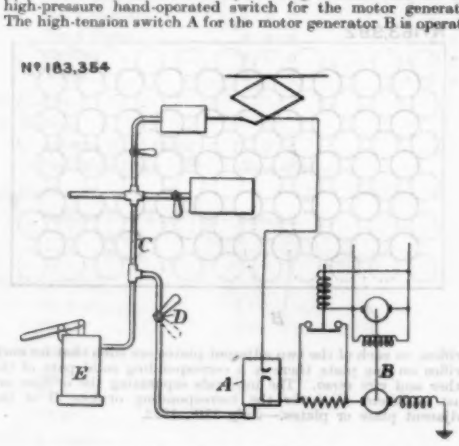


the movement leaves the pulley at the greatest possible distance from the point of rotation. Arrangements are also provided for working the facing point lock D from the cam shaft.—*July 27th*, 1922.

183,354. July 18th, 1921.—IMPROVEMENTS RELATING TO ELECTRIC CONTROL SYSTEMS, Robert Brooks, of Lyndhurst, Harborough-road, Ashton-on-Mersey, Cheshire; and the Metropolitan-Vickers Electrical Company, of 4, Central-buildings, Westminster.

This specification describes a scheme for starting a motor generator for supplying a low-tension control system on a high-pressure electric train, the object being to avoid the use of a high-pressure hand-operated switch for the motor generator. The high-tension switch A for the motor generator B is operated

No 183,354



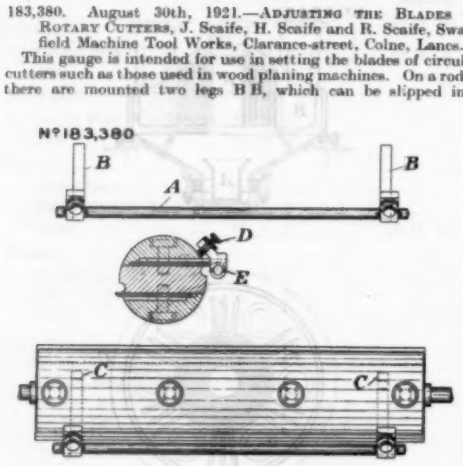
from the pneumatic system C by means of a control cock D, a hand pump E being provided when the air pressure cannot be obtained from the electrically operated compressor. Obviously, with this arrangement the high-pressure switch for the motor generator B can be placed near the other switches and not in the driver's compartment.—*July 27th*, 1922.

MACHINE TOOLS AND SHOP APPLIANCES.

183,380. August 30th, 1921.—ADJUSTING THE BLADES OF ROTARY CUTTERS, J. Scaife, H. Scaife and R. Scaife, Swanfield Machine Tool Works, Clarance-street, Colne, Lancs.

This gauge is intended for use in setting the blades of circular cutters such as those used in wood planing machines. On a rod A there are mounted two legs B B, which can be slipped into

No 183,380



recesses C C formed in the clamping plates of the cutter block. Thumbscrews D, which bear against the block, are used to adjust the brackets E, so that they just touch the edge of one blade. The gauge is then applied to the other blade, which is set to correspond with the first one.—*July 27th*, 1922.

WELDING.

183,262. April 23rd, 1921.—IMPROVEMENTS IN ELECTRODES SUITABLE FOR RESISTANCE WELDING PROCESSES, Richard Franklin Woodburn, of Industry Works, Sunbridge-road, Bradford.

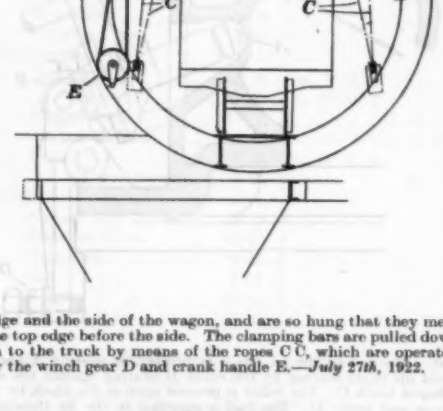
In the application of resistance welding to materials having a high conductivity, such as aluminium or copper, difficulties have been experienced. Apparently the success of resistance welding depends upon the application of a sudden localised heat. It has not been possible with the usual methods to obtain heat which is suddenly localised, and directly the heat spreads, burning and other deleterious effects result. According to this invention the welding electrodes are composed of a material having a high melting point relatively to the material which is to be welded by them, and also a high conductivity. Suitable materials are the following substances:—Iridium, gold, platinum, tungsten and tantalum, which metals have low specific heats and high melting points. Other alloys are, however, available which have low specific heats and high melting points, and these would also be suitable for use according to the invention.—*July 24th*, 1922.

CRANES AND CONVEYORS.

183,397. December 5th, 1921.—ROTARY WAGON TIPPLERS, Babcock and Wilcox, Limited, Oriel House, Farringdon-street, London, E.C. 4; and H. Donaldson, 16, Sandy-road, Renfrew.

This invention is concerned with the means used to clamp railway trucks in rotary tipplers. The clamping bars A are provided with pivoted pieces B B which engage with the top

No 183,397



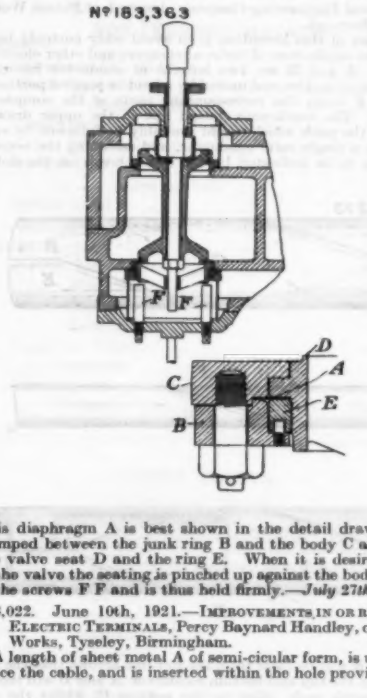
edge and the side of the wagon, and are so hung that they meet the top edge before the side. The clamping bars are pulled down on to the truck by means of the ropes C C, which are operated by the winch gear D and crank handle E.—*July 27th*, 1922.

MISCELLANEOUS.

183,363. August 5th, 1921.—DOUBLE-BEAT VALVES, Cockburns Limited, D. Cockburn, and D. MacNicoll, Clydesdale Engineering Works, Cardonald, near Glasgow.

In this double-beat valve the lower seating is attached to the body by means of a flexible diaphragm, so that it may accommodate itself to the expansion and contraction of the various parts.

No 183,363

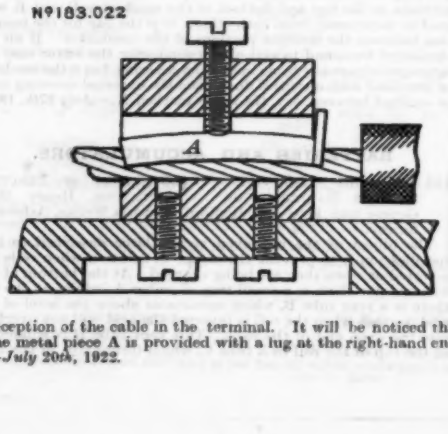


This diaphragm A is best shown in the detail drawing and is clamped between the junk ring B and the body C and between the valve seat D and the ring E. When it is desired to grind in the valve the seating is pinched up against the body by means of the screws F F and is thus held firmly.—*July 27th*, 1922.

183,022. June 10th, 1921.—IMPROVEMENTS IN OR RELATING TO ELECTRIC TERMINALS, Percy Baynard Handley, of Britannia Works, Tyseley, Birmingham.

A length of sheet metal A of semi-cicular form, is used to embrace the cable, and is inserted within the hole provided for the

No 183,022



reception of the cable in the terminal. It will be noticed that the metal piece A is provided with a lug at the right-hand end.—*July 20th*, 1922.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TUESDAY TO FRIDAY, SEPTEMBER 5TH TO 8TH.

IRON AND STEEL INSTITUTE.—Autumn meeting at York. For programme see page 96.

WEDNESDAY TO WEDNESDAY, SEPTEMBER 6TH TO 13TH.

BRITISH ASSOCIATION.—Meeting at Hull.

WEDNESDAY, SEPTEMBER 13TH.

THE INSTITUTION OF LOCOMOTIVE ENGINEERS: MANCHESTER CENTRE.—Visit to the carriage and wagon works of the Great Central Railway at Dukinfield. Members will meet at London-road Station, G.C.R., and leave by special train at 2.30 p.m.

SATURDAY, SEPTEMBER 16TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Eastern District meeting at Luton. London members will leave St. Pancras by the 9.25 a.m. train.

WEDNESDAY TO FRIDAY, SEPTEMBER 20TH TO 22ND.

THE INSTITUTE OF METALS.—Swansea. Annual autumn meeting. For Programme see page 152.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. EDGAR W. DOREY, of Norwich House, Southampton-street, High Holborn, London, W.C. 1, has been appointed sole agent for the United Kingdom for the Anglo-Belgian Company, Limited, of Ghent.

LEDWARD AND BECKETT, Limited, inform us that on September 1st next they are moving their offices from King's House, King-street, London, E.C. 2, to Parliament Mansions, Victoria-street, Westminster, S.W. 1.

BOWES-SCOTT AND WESTERN, Limited, inform us that on September 1st next they are moving their offices from King's House, King-street, London, E.C. 2, to Parliament Mansions, Victoria-street, Westminster, S.W. 1.

MR. THOMAS ADAMS, F.S.I., and Mr. Longstreth Thompson, announce that they have entered into a partnership for the purpose of practising as town planning consultants, with offices at 121, Victoria-street, Westminster, S.W. 1 (Telephone: Victoria 7087), and 16, East 41st-street, New York.

THE address of the Department of Technology of the City and Guilds of London Institute has been changed to 29, Roland-gardens, Old Brompton-road, South Kensington, S.W. 7. The telephone number is unchanged (4424 Kensington), but the telegraphic address is now "Civic, Fulroad, London."

CHARLES FENNESSY AND CO. have commenced business at 55, Avenue-chambers, Southampton-row, London, W.C. 1, as consulting engineers and representatives for engineering specialties. The partners are Mr. A. C. D. Meyjes, A.M. Inst. C.E., A.M.I. Mech. E., and Mr. R. F. Jones, 1st Cl. B.O.T. Certif. (R.N. Spec. Res.).

ENGINEER VICE-ADMIRAL SIR GEORGE GOODWIN, K.C.B., late Engineer-in-Chief of the Fleet, and Dr. James Colquhoun Irvine, O.B.E., F.R.S., Vice-Chancellor and Principal of St. Andrews University, have been appointed by an Order of Council dated August 10th, 1922, to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research.

LAUNCHES AND TRIAL TRIPS.

DORIC; twin-screw passenger vessel; built by Harland and Wolff, Limited, Belfast, to the order of the White Star Line; dimensions, 600ft. 9in. by 67ft. 6in. by 45ft. 6in.; to carry 16,600 gross tonnage. Engines, single-reduction geared turbines, pressure 215 lb.; launch, August 8th, 1922.

BENDIGO; twin-screw passenger vessel; built by Harland and Wolff, Limited, to the order of the Peninsular and Oriental Steam Navigation Company; dimensions, 520ft. by 64ft. by 41ft. Engines, twin-screws, quadruple-expansion; constructed by the builders; handed to owners, August 9th, 1922.

HOWRA; steel screw steamer; built by Armstrong, Whitworth and Co., Limited, to the order of the British India Steam Navigation Company; dimensions, 441ft. 6in. by 55ft. 6in. Engines, one set of turbines working through double-reduction gearing, pressure 190 lb. per square inch; trial trip, August 9th, 1922.

BRITISH GUNNER; oil tank steamer; built by Swan, Hunter and Wigham Richardson, Limited, to the order of the British Tanker Company, Limited, of London; dimensions, 455ft. by 57ft. beam; to carry 10,000 tons. Engines, turbines of the Metropolitan-Vickers Rateau type; constructed by the builders; launch, August 10th, 1922.

SAN MACEDONIO; oil tank steamer; built by Palmer's Shipbuilding and Iron Company, Limited, to the order of the Eagle Oil Transport Company, Limited; dimensions, 422ft. by 52ft. 4in. by 31ft. 6in.; to carry 8250 tons deadweight. Engines, triple-expansion, 27½in., 46in., 77in., by 48in. stroke, pressure 180 lb.; constructed by the builders; launch, August 22nd.

COLORADO; steamer; built by William Gray and Co. (1918), Limited, to the order of the Ellerman Lines, Limited; dimensions, 450ft. 9in. by 57ft. 3in. by 32ft. 10in.; to carry 10,600 tons deadweight. Engines, double-reduction geared turbines, pressure 225 lb. per square inch; constructed by the builders; launch, August 23rd, 1922.

SHILDON; steel screw collier; built by the Blyth Shipbuilding and Dry Dock Company, Limited; dimensions, 298ft. overall, with 42ft. beam. Engines, triple-expansion, 22in., 36in., and 60in. by 39in. stroke; constructed by the North Eastern Marine Engineering Company, Limited; launch, August 23rd, 1922.

MONGOLIA; intermediate liner; built by Sir W. G. Armstrong Whitworth and Co., Limited, to the order of the Peninsular and Oriental Steam Navigation Company; dimensions, 570ft. by 72ft. by 42ft. 3in.; to carry 13,000 tons deadweight. Engines, two independent sets of Parson's geared steam turbines, pressure 200 lb.; constructed by the builders; launch, August 24th, 1922.

BRITISH PREMIER; geared turbine oil tank steamer; built by Palmer's Shipbuilding and Iron Company, Limited, to the order of the British Tanker Company, Limited; dimensions, 415ft. by 54ft. by 33ft.; to carry 8400 tons deadweight. Engines, single-screw double-reduction geared turbines, pressure 200 lb. per square inch; constructed by the builders; launch, August 25th, 1922.